DTIC/TR-89/13

AD-A211 501

ADP Strategy Team Report:
A Future DTIC ADP System

S. Atchison
R. Bennertz
G. Cotter
R. Knez
E. McCauley
Defense Technical Information Center

15 September 1983

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

1b. RESTRICTIVE MARKINGS

2a. SECURITY CLASSIFICATION AUTHORITY

2b. DECLASSIFICATION / DOWNGRADING SCHEDULE

3. DISTRIBUTION / AVAILABILITY OF REPORT
Approved for public release; distribution unlimited

4. PERFORMING ORGANIZATION REPORT NUMBER(S)
DTIC/TR-89/13

5. MONITORING ORGANIZATION REPORT NUMBER(S)

6a. NAME OF PERFORMING ORGANIZATION
Defense Technical Information Center

6b. OFFICE SYMBOL (If applicable)

7a. NAME OF MONITORING ORGANIZATION
Defense Technical Information Center

6c. ADDRESS (City, State, and ZIP Code)
Cameron Station
Alexandria, VA 22304-6145

7b. ADDRESS (City, State, and ZIP Code)
Cameron Station
Alexandria, VA 22304-6145

8a. NAME OF FUNDING / SPONSORING ORGANIZATION

8b. OFFICE SYMBOL (If applicable)

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c. ADDRESS (City, State, and ZIP Code)

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
ADP Strategy Team Report: A Future DTIC ADP System

12. PERSONAL AUTHOR(S)
S. Atchison, R. Bennertz, G. Cotter, R. Knez, E. McCauley

13a. TYPE OF REPORT

13b. TIME COVERED
FROM ________ TO ______

14. DATE OF REPORT (Year, Month, Day)
830915

15. PAGE COUNT
81

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

While the Defense RDT&E On-Line System (DROLS) was at the edge of the state-of-the-art in the 1960's and early 1970's, it is no longer. The ADP technology explosion has far outdistanced DTIC's ADP systems and if DTIC is to satisfactorily perform its DoD(USDR&E) Scientific and Technical Information Program (STIP) duties and responsibilities, a revised information delivery system must be developed. The purpose of this paper is to document DTIC's present situation; highlight future ADP technology trends in the information processing field; lay out general functional requirements depicting how DTIC should operate in the future; identify and contrast ADP system configurations based on future ADP technology and DTIC mission assumptions in terms of cost, performance, and other pertinent factors; and provide a plan depicting the steps which must be taken to accomplish the system upgrade.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT
☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION
UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL
Gladys A. Cotter

22b. TELEPHONE (Include Area Code)
(703) 998-4693

22c. OFFICE SYMBOL

DD Form 1473, JUN 86

Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

ADP STRATEGY TEAM REPORT

A FUTURE DTIC ADP SYSTEM

September 15, 1983

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

INTRODUCTION

The Defense Technical Information Center (DTIC) is the clearinghouse for Department of Defense (DoD) research and engineering (R&E) information in virtually all fields of science and technology, a service DTIC and its predecessor organizations have been providing to the DoD community since 1951. In the 1960's, DTIC automated its information retrieval system and later, during the end of the 1960's and early 1970's, enhanced its information retrieval service by allowing users to interrogate the system interactively from remote sites. This Defense RDT&E On-Line System became known as DROLS.

Over the past 12+ years, the number of terminals accessing DROLS use has grown significantly, far surpassing its targeted limits. Today over 500 separate terminal users in both synchronous and asynchronous modes are being serviced. Projections call for ever greater growth through 1995 to 2,000 asynchronous and 300-400 synchronous terminal users. DROLS' present configuration could not sustain this growth. Furthermore, the need to add new, capabilities to the system such as on-line dup checking, Boolean set logic, etc., has proven technologically difficult because of current system design. Likewise, adding new data bases to accommodate the needs of the R&D user community is difficult to accomplish in an inexpensive and timely manner because of the high demand on available resources required just to maintain the current system in an operational state.

While DROLS was at the edge of the state-of-the-art in the 1960's and early 1970's, it is no longer. The ADP technology explosion has far outdistanced DTIC's ADP systems and if DTIC is to satisfactorily perform its DoD(USDR&E) Scientific and Technical Information Program (STIP) duties and responsibilities, a revised information delivery system must be developed. The purpose of this paper is to document DTIC's present situation; highlight future ADP technology trends in the information processing field; lay out general functional requirements depicting how DTIC should operate in the future; identify and contrast ADP system configurations based on future ADP technology and DTIC mission assumptions in terms of cost, performance, and other pertinent factors; and provide a plan depicting the steps which must be taken to accomplish the system upgrade.

SECTION 1

DTIC at Present

A. Mission Responsibilities

B. Products and Services

C. ADP Configuration

D. Known/Reported ADP Problems

A. MISSION RESPONSIBILITIES

The Scientific and Technical Information Program (STIP), under the overall policy direction and control of the USDR&E, ensures that STI generated by Research and Engineering (R&E) programs provides maximum contribution to the advancement of science and technology; permits timely, effective, and efficient conduct of the DoD R&E programs; provides information support to the management of R&E-related programs; and eliminates unnecessary duplication of effort and resources by encouraging and expediting the interchange and use of STI.

Under the operational control of DLA, DTIC is responsible for executing the following functions in support of STIP:

1. Acquiring and maintaining a repository of technical documents of DoD R&E and studying efforts for use by the DoD technical community. This includes monitoring an STI data base to support an on-line search and retrieval service, and other data base output products such as document announcement, current awareness, selective dissemination of information products, or bibliographic searches.

2. Providing support and services to DoD-funded IACs. The purpose of this function is to improve the visibility, effectiveness, and use of the IACs in support of DoD and federal scientific and technical programs through promoting resource sharing, joint approaches to common objectives and problems, and information exchange among the IACs, DTIC, and other components of STIP.

3. Providing centralized technical support to DoD technical libraries. In this regard DTIC analyzes and explores applications of automation to library operations and other services. Coordinates cooperative efforts among libraries including the establishment of networks and resource sharing.

4. Ensuring that the overall STIP is served by innovative and effective information systems that take advantage of new advances in information science and technology. To accomplish this satisfactorily, DTIC must acquire and test the application of existing and promising computer, telecommunications, storage, and transmission devices and concepts.

B. PRODUCTS AND SERVICES

DTIC's current data repository contains information that can be exploited to answer three basic questions related to the DoD Research, Development, Test, and Evaluation (RDT&E) program. These questions are:

1. What research is being planned?

2. What research is currently being performed?

3. What results were realized by completed research?

Research and development activities within the United States Government and their associated contractors, subcontractors, and grantees, with current government contracts, are eligible to receive most of the information located at DTIC.

There are collections, however, that contain proprietary data or information compiled for the specific purpose of DoD management decisions which are made available to Defense components only.

The "heart" of the DTIC data repository consists of four computer-accessible data bases from which all user interrogations are made.

1. R&D Program Planning Data Base (R&DPP) - A collection of future DoD projects planned for research and development in the next 5 years. The directive requiring input to this data base was cancelled in June 1982 and a search is currently being made for a replacement. It was frozen at 41,200 documents and still produces 100 bibliographies a month from a high of 165 a month in FY 81. There was a high of 800 interrogations a month in FY 82 by outside users.

2. Research and Technology (R&T) Work Unit Information System (WUIS) Data Base - A collection of technically-oriented summaries describing R&T projects currently in progress at the work unit level. The data base includes information concerning the what, where, when, how, at what costs, by whom, and under what sponsorship research is being performed. There is a total of 160,000 records in the WUIS with approximately 24,000 active at one time. Approximately 850 new records are added per month. From an estimated 4,600 interrogations a month, 790 bibliographies are ordered. In addition, 400 bibliographies a month are ordered through recurring reports.

3. Technical Report (TR) Bibliographic Data Base - A collection of (bibliographic) citations to formally document scientific and technical results of Defense-sponsored RDT&E. There are approximately 1.2 million citations in the data base and 338,000 documents in an older, off-line collection, with approximately 2,500 new citations input each month.

A variety of programs, products, and services is available from the technical report collection which includes bibliographies, automatic document and tape distribution, selective dissemination of information, etc. From approximately 55,000 interrogations per month, an estimate of 1,760 bibliographies are produced. In addition, 4,000 bibliographies per month are produced through the selective dissemination of information. The documents themselves may also be ordered through DTIC. Currently, around 31,000 documents are ordered a month.

4. Independent Research and Development (IR&D) Data Base - A data base of information describing the technical programs being performed by DoD contractors as part of their independent research and development programs. This program is directed toward continual advancement of technological competence. There are approximately 53,000 records in the data base. From

approximately 600 interrogations a month, around 85 bibliographies are produced. In addition, approximately 160 bibliographies per month are produced through the recurring reports program.

This research is not wholly funded by a DoD agreement; therefore, it is considered proprietary information, and exempt from disclosure under the Freedom of Information Act.

DTIC obtains STI reports through an internal DTIC acquisition, evaluation, and selection program. This program is designed to maintain high standards for accepting reports into the DTIC collection, while providing for maximum interchange of information.

Reports are received from government installations, industrial contractors, universities, and non-profit organizations participating in the RDT&E program and are submitted generally at the time of primary distribution. DTIC reviews all reports and selects only those considered significant to be added to its data base repository.

DTIC offers a variety of products and services to its user community:

1. Technical Abstract Bulletin (TAB) - A bi-weekly listing of all new classified and unclassified/limited scientific and technical reports received by DTIC within the processing cycle. TAB and its indexes are now classified.

For announcement purposes, the technical reports are grouped into a two-level arrangement consisting of 22 major subject fields with further subdivision into 188 related subject groups, and assigned an AD number for requesting and retrieval purposes.

2. Technical Abstract Bulletin Indexes (TAB-I) - Attached to the back of TAB, issued to assist in identifying accessions of particular interest. The publication includes eight indexes to list AD numbers, corporate author-monitoring agency, subject, title, personal author, contract number, report number, and release authority. Each report entry lists the AD number and the subject field/group number where the complete announcement appears in TAB, with the exception of the Release Authority Index which does not list field/group arrangement.

3. Cumulative Indexes - The TAB Annual Indexes are published to list documents by subject, sources, personal authors, contract and report numbers, titles, and release authority.

4. Automatic Document Distribution Program (ADD) - Microfiche copies of newly accessioned reports selected according to a user's subject interest. This service anticipates a user's need through a comparison of subject interest profiles against a computer data base of accessioned technical reports as they are announced in TAB.

5. Bibliography Program - Listings of technical reports related to specific subjects. A computerized search is made of the DTIC collection to

list applicable reports with control numbers, informative abstracts, and descriptive data of research projects.

(Most of the technical reports submitted to DTIC contain a DD Form 1473 which includes abstracts and descriptive data. If an abstract is not received with the report, DTIC analysts summarize subject coverage. This enables DTIC to provide a more comprehensive bibliography program for its users.)

The two main types of bibliographies offered by DTIC which differ in depth of search, response time, and product format are demand and current awareness. However, on-line search results can be printed at DTIC on request as well.

While each provides a customized bibliography in response to specific needs, only the current awareness bibliography provides a recurring service on an automatic 2-week cycle to cover newly accessioned DTIC documents.

6. Recurring Management Information System Reports - Reports compiled monthly, quarterly, semiannually, or annually from management information systems in formats designed by the recipient organizations. These reports, which are separate compilations from the data contained in the WUIS, R&DPP, and IR&D data bases, may be requested on a demand basis or on the automated recurring procedure.

C. ADP CONFIGURATION/OPERATION

Presently the DTIC ADP system configuration consists of two UNIVAC computers and a UNIVAC front-end communications processor:

1. The larger and faster, a UNIVAC 1100/82 computer, provides the R&D community direct, dynamic, and rapid access to technical and management information, and supports the bulk of DTIC's ADP production work.

2. A smaller but versatile processor, the UNIVAC 1100/60 computer, is used to support the remaining off-line and "batch" processing as well as to provide time sharing services to authorized DTIC R&D engineers and managers.

3. A UNIVAC DCP 40 front-end processor is used exclusively with the UNIVAC 1182 and DROLS for communications message control.

The center of activity between DTIC and its user community and the products and services provided is DROLS. This network of 500+ geographically remote and 50+ in-house terminals is linked to DTIC's UNIVAC 1100/82 computer for on-line visual display of data from the four previously described data base collections - the TR, R&T WUIS, R&DPP, and to a limited degree, the IR&D data bases. Selected participation of direct keystroking of input data with off-line editing and file updating is also permitted.

A typical synchronous cathode ray tube (CRT) terminal configuration consists of an input/output CRT display and a page printer. A magnetic tape cassette subsystem is also available for use with the system. The user queries the system by typing a command with appropriate data on the terminal console and depressing the TRANSMIT button. The response is displayed on the screen a few seconds later. By using various commands, the user is able to switch from one data base to another in pursuit of information retrieval, and to print out on the printer associated with the terminal a hard (paper) copy of the current CRT screen display or the information may be recorded on the tape cassette system for later review and printing. A dial-up asynchronous terminal configuration typically consists of a keyboard with printer although CRTs may be used. To the user, DROLS performs similarly to the synchronous mode except all transmissions are sent and received character or line at a time rather than screen at a time.

Current and proposed user terminal stations include the Deputy Under Secretary of Defense R&E (Research and Advanced Technology), Army, Navy, and Air Force facilities, Information Analysis Centers, other Federal Government organizations, DoD contractors, and special terminal facilities made available for DTIC - registered users in Los Angeles, Washington, DC, and Boston areas.

Both unclassified and classified modes of operation are provided by DROLS. In a classified mode, a dedicated line is required for communications; in an unclassified mode, a dedicated or dial-up line can be used. Unclassified users are restricted to unclassified displays of unclassified and unclassified limited documents on the CRT screen but they may order classified technical reports and bibliographies if their facility is cleared to receive classified information.

Information currently stored in the DTIC computer system includes the master and inverted files of the four data bases, central registry of users, natural language data base, corporate author files, hierarchy files, remote terminal input system files, and data files for certain selected sites for the on-line system input. The data from these files are stored by several techniques to enable subsequent retrieval to satisfy a multitude of users and requests on an instantaneous basis.

D. KNOWN/REPORTED ADP PROBLEMS

1. Response time.

Response time is very erratic and at times much too slow to satisfy user on-line needs. Significant response variations occur running the same search at different time periods. This is due mainly to the load on a given activity within DROLS at the particular point in time a search is submitted. For example, in a series of single descriptor test searches that were run on the asynchronous dial-up terminals during July and August 1982, the following results were recorded:

On a Wednesday morning before 9 a.m. the response time varied from 2:46 to 46:33 seconds. The next morning the response varied from 2:10 to 31:12 seconds.

In the early afternoon the variations were even greater. On a Wednesday at 1:30 p.m. the range went from 2:59 to 78:65 seconds. On a Monday at 1:10 p.m. the range was 2:03 to 71:92 seconds.

In the late afternoon on a Wednesday at 3:47 p.m. the response time varied from 2:26 seconds to 13:25 seconds. However, on a Monday at 4:50 p.m. the range varied from 1:77 to 27:56.

2. Lack of system availability.

Hours of operation and number of ports available are too restrictive. Currently DROLS operates from 800 to 1930 ETZ daily with the peak activity period from 1100 to 1300. During this peak period, response time degradation is noticeable and system accessibility is difficult. West Coast users are unfairly penalized. Weekend operation is permitted to special users only upon prearranged request with DTIC.

3. Lack of system portability/flexibility.

Much of the system is "home-grown" in UNIVAC-dependent assembly language. An effort is underway to convert to High Order Language. Some UNIVAC or UNIVAC-compatible "off-the-shelf" software is used. Various files are in FIELDDATA or ASCII code using several formats. System hardware, including certain terminals, must be UNIVAC or UNIVAC-compatible. Portability and flexibility options are limited.

4. Lack of system reliability.

Since all data base queries are performed via DROLS, any occurrence of hardware, software, or administrative problems potentially impact satisfactory operation of DROLS; hence an inability to guarantee system reliability and integrity.

5. Lack of easily modifiable software.

Due to differences in formats of files and other system modifications which have occurred over the years, interfaces are needed for translation between files and between old files and modern code. Patches that have grown up over the years make the code difficult to read. This problem is compounded by the older code's lack of documentation.

6. Simplicity.

A common complaint by DROLS users is that the system is not user-friendly, not [illegible] ..cion difficult to use. Most industry accepted standards are not included in DROLS, i.e. set logic, free-text searching and relational searching, etc. Training for DROLS requires 3 to 5 days versus

1 or 2 days for commercial systems. The extended training is required because of the complexity of the data bases (i.e. data element incompatibility) and the uniqueness of the DROLS searching techniques.

SECTION 2

Functional Requirements

A. General

B. ADP Subsystem

C. Data Input

D. Document Input/Output

E. Management Information

F. Network Services

G. Retrieval

H. Request Processing

I. User Services

A. GENERAL

DTIC's functions for the next 10 years will be similar to those performed now and include the general categories of acquisitions, technical processing, product distribution, network services, user services, and development services. The significant difference portrayed in these functions is the emphasis on automation, closer user ties, quicker response, less cost, less redundancy, more sharing, larger collections, and greater overall flexibility and reliability in information transfer. It should be noted that this section does not intend to imply any particular type of system configuration...it is described from a simplistic user point of view.

The following are brief descriptions of the users of DTIC's ADP system:

1. In-house Users:

a. Administrative Services - Consists of DTIC managers, the management offices and the Office of the Administrator who are responsible for the guidance and control of DTIC's mission and functions. These users are interested in management information and decision support information.

b. Acquisitions - Consists of those users involved in the locating and acquiring of technical information that is not input into the DTIC data bases.

c. ADP Services - Consists of individuals who must provide the ADP design and maintenance programing support and operational computer support for all users of DTIC's ADP services.

d. Development Services - Consists of individuals who support state-of-the-art long and intermediate range projects that may alter the course of normal DTIC operations.

e. Document Storage - Consists of users who are responsible for the physical storage, retrieval, duplication, and shipping of the "full-text" technical information.

f. Network Services - Consists of individuals who support DTIC's networking activities such as the gateway and the Shared Bibliographic Input Network (SBIN).

g. Product Distribution - These are the users who are responsible for ordering and the validation (this includes blanket release) for access to DTIC's technical information and for the processing of system rejection of orders.

h. Reference/Retrieval - These are the users who are responsible for identifying individual documents or groups of citations in the DTIC data bases that are relevant to a user's request.

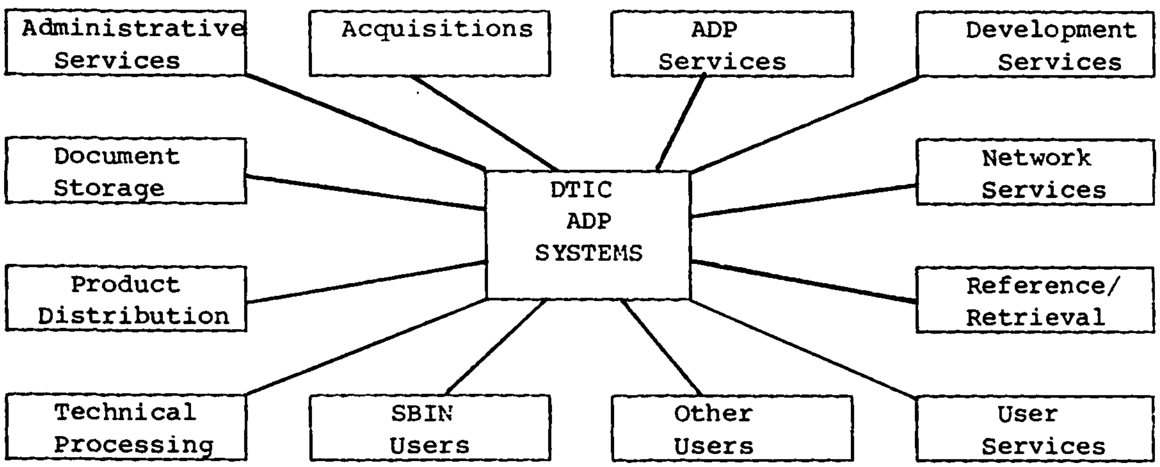
i. Technical Processing - Represents the individuals who are responsible for input and maintenance of data in DTIC's data bases. The particular functions include selection, cataloging, indexing, and editing.

j. User Services - Includes individuals who directly serve the DTIC user community in the areas of registration, complaint processing, and training. They track orders and lost documents.

2. External Users:

a. Shared Bibliographic Input Network - These users are very similar to the in-house technical processing group. They are responsible for the input of technical data into DTIC's data bases.

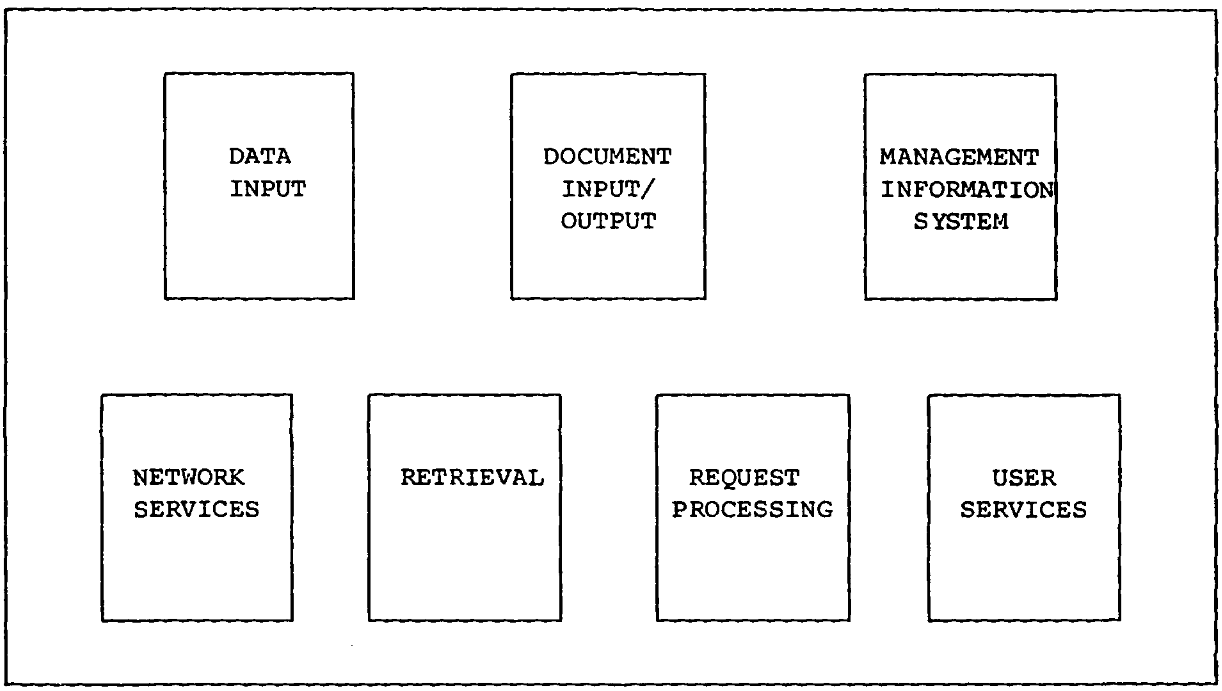
b. Other Users - These users are similar to the in-house reference/retrieval function. They are either responsible for identifying individual documents or groups of citations in the DTIC data bases that are relevant to their internal requests or maintaining several "special" data bases or DTIC system capabilities such as MATRIS and the DTIC Time Sharing Service (DTSS).



B. ADP SUBSYSTEM

All of the previously described functions join together to make overall requirements for DTIC's ADP system. Because actual ADP requirements overlap there is no clear breakout of ADP subsystems by organizational function. However, the following ADP requirements have been grouped into the following logical subsystems. While the subsystems are described separately on the following pages this does not mean to imply that there are no interrelationships among subsystems.

DTIC ADP SUBSYSTEMS



C. DATA INPUT

Primary Users: DTIC Catalogers/Indexers
DTIC Acquisition Staff
Shared Bibliographic Input Network Participants
DoD R&D Agents
DoD Acquisition Librarians
IAC
MATRIS

Secondary Users: Reference/Retrieval
Contract Monitors
DTIC Users
Document Reproduction
Administrative Services
Request Processing

Purpose:

1. To provide a user-friendly, on-line, interactive mechanism for submitting bibliographic and management data to DTIC for dissemination to the DoD community.

2. To allow users to tag records in DTIC's system with information which is useful locally but will be transparent to the overall community of users.

3. To provide compatible subsets of the system to users for local installation.

4. To provide on-line catalogs for DTIC users.

5. To provide an acquisition subsystem for DTIC and DTIC users.

6. To support information resource sharing in the DoD community.

7. To realize economies in terms of time and monies by using the most advanced data input procedures and techniques.

Current System Description:

1. Scope/General Characteristics

The input system is used for entering referral data to build DTIC's four existing data bases. In the technical report system only citations to the reports are entered in the data base, not the documents themselves. The data elements used are a mixture of short fields such as author or principle investigator and longer fields such as abstract or summary of findings. Fixed and variable length field data are input to the DTIC data bases.

Data is entered using the Remote Terminal Input Subsystem (RTIS). Information is updated to the current file (CF) twice daily at 1200 and at 1900 hours. Data in the CF is searchable by descriptive data elements such as author, title, and date but not by subject terms. Every 2 weeks

information in the CF is updated to the Technical Report (TR) file. The Technical Abstract Bulletin (TAB) and the Current Awareness Bulletin (CAB) are based on this update.

System users proceed in the following manner. They enter retrieval mode and check for duplicates in the CF and the TR file. These searches must be made separately. If the search results indicate a possible duplicate the record is displayed. Based on the results of the searches, a site enters the input mode to add holdings information or input an original record. After completing this action, the site flags the information to indicate that it should be updated to the CF.

Based on technologies of the 1960's, the system lacks many features which are commonplace today even on word processors. It emphasizes centralized processing but allows data input to be done either centrally or remotely through terminals. There are no help, prompt, or menu features available. Users attend a 1-week training course to learn the system. However, it takes several months of constant use to acquire system proficiency, and skills fade rapidly without regular use.

2. Data Input Methods

DTIC accepts cards, magnetic tape, and on-line terminal input. Card and magnetic tape input are processed centrally whereas on-line input can originate from in-house and remote terminals. Input can be accomplished using dedicated or dial-up terminals. Dedicated input requires UNIVAC terminals. (This should change due to the front-end processor.) Data can be keyed-in in an interactive mode or it can be transmitted from a UNIVAC cassette machine by users with the necessary terminal configuration. Dial-up input is done using direct dial to DTIC or through TYMNET connection. This type of input must be done in an interactive mode, because the system will not accept input from a tape or disk.

3. Data Editing/Validation

In the dedicated mode, system users enter a screen of data at a time. The data on the screen is edited by moving the cursor to correct mistakes, delete characters, and add characters. These editing capabilities are in common usage today. However, for the type and volume of data input the editing capabilities are sufficient.

In dial-up mode, system users transmit data a character at a time. Editing can be accomplished using the backspace, line delete, and editing commands. The editing commands require that the user type the incorrect information followed by the correct information. These editing routines are very cumbersome and time-consuming. They are unsatisfactory unless data volume is very low. All input data which is updated to the current file is manually reviewed by an editing branch.

4. Security

Using dedicated terminals with proper security constraints, unclassified or classified data up through secret can be input from in-house or remote

terminals. Using unclassified dedicated or dial-up terminals, data referencing unclassified and unclassified limited technical reports can be input along with unclassified WUIS data.

Proposed System Description:

1. Scope/General Characteristics

The input system will be used for entering references and actual source data. It will be used to build DTIC's data bases and local data bases. The system should be modular in design so that subsets can be provided to the user community for local use. Users should be able to tag and append information to records which is useful to them but which would be transparent to the general user community. Users should be able to dup check and input data without switching between files. Users should be able to dup check using a single search. The system should be user-friendly and provide help, prompts, and menus in addition to a streamlined "production-oriented" input mode. There should be a prepublication file which could be used by publication centers and contract monitors to track progress of in-process reports and deliverables. An acquisition file should be available for use by the DTIC acquisition staff, DTIC reference staff, and DTIC users to describe items they are trying to acquire. In some cases, DTIC will route the acquisition requests to other facilities to have the order filled. Records in the prepublication and acquisition files should be built on to form a complete record of availability, tracking, and bibliographic information as data is received.

A system manual and computer-aided instruction should be provided. The goal is for a user to be proficient in using the system in a matter of days. In addition, input training will be offered at DTIC.

2. Data Input Methods

The data input system should be conversational, interactive, and support central and remote input processing. The system should be capable of accepting both classified and unclassified input.

The input system will be a user-friendly, integrated package which will support electronic mail, word processing, graphics, data input, and other functions valuable to DoD R&D agents.

Users will be able to input data using standard and state-of-the-art technologies. Terminal, magnetic tape, video disk, optical character recognition, disk, and voice input will be acceptable input techniques. More word processors, microcomputers, and intelligent workstations will be used for input, and users will be able to take advantage of their full range of capabilities.

3. Data Editing/Validation

User-friendly editing and validation routines will be available.

4. Security

Using dedicated terminals with proper security constraints, unclassified or classified data up to the secret level should be eligible for input from in-house or remote terminals. Using dedicated or dial-up terminals, unclassified data referencing work up to the top-secret level should be eligible for input over value-added networks supporting the Data Encryption Standard (DES).

5. Functions

- o Dup Check
- o Data Input
- o General Announcements
- o Cataloging Tool
- o Acquisitions

Constraints/Expectations:

1. Downtime: Not to exceed 1 percent per month. System should be available as a minimum from 0600 ETZ to 2000 PTZ, 6 days a week.

2. Response time: Average 5- to 10-second response time with 200 users inputting data at any one time.

3. Volume: Process 500 to 1000 new records per day.

4. Resources:

Personnel - Minimal impact on personnel. Fewer catalogers and indexers will be needed at DTIC. Additional DTIC personnel will be required for quality control. These effects will balance each other out resulting in a reduction or status quo in number of personnel.

5. Geographical location of users: World-wide.

D. DOCUMENT INPUT/OUTPUT

Primary User/s: Document Storage

Secondary User/s: Reference/Retrieval Services
Acquisitions
User Services
ADP Services
SBIN Participants
DTIC Users

Purpose: The purpose of the document input/output system will be fourfold:

1. To allow various forms of input into the technical report collection including:

   a. hard copy reports including nonstandard formats,

   b. various forms of micromedia, and

   c. digital input.

2. To store and control this information in a single standard format or file.

3. To allow retrieval of stored documents in a high-resolution format suitable for display on a high-resolution graphics terminal and to allow for the automated reproduction of high-quality hard copy or microforms for permanent distribution to the end user.

4. To limit costly human resources by using advanced automated document storage and retrieval systems.

Current Process:

The document input/output system is currently a totally manual process. Reports are prepared for filming, photographed, developed, reviewed for quality, and stored in roll-o-matic microfiche storage devices. To reproduce a document, the microfiche must be pulled from storage, copied on a diazo duplicator (for microfiche copies) or Xerox 970 (for hard copies), merged with mailing labels, packaged for shipping, and mailed to the requestor. Problems that exist for the current system are: deterioration of emulsions in the films and a reduction in reproduction quality over time; lost documents due to misfile or documents already out-of-file due to request; high staff turnover due to low grade structure; human errors in the reproduction and shipping process; and no way to enhance quality of a poor quality technical report.

Proposed Process:

The document input/output system will include advanced technologies in image processing, communications, and computer software to allow for the full text storage of documents. The capture methods will be through direct communications link with document producers, digital scanning of reports in various formats, and word processors or like interfaces. Image enhancement will be an integral part of the process.

The storage medium will be designed to utilize digital optical recording technology (video laser disk) or equivalent state-of-the-art technology as the permanent archival record. The stored files will be accessible via high-resolution video display terminals. This will allow regional as well as local offices to access millions of records via telecommunications networks. A permanent copy can be obtained by sending page images to a high resolution COM unit or hard copy printer (such as a Xerox 9700). Other media may be used as the need arises, but emphasis will be placed on three standards: video images, COM microfiche, or hard copy.

Orders for documents coming from users by telephone, mail, or through the on-line retrieval system will be sent to the request processing system and then to the document input/output system.

Constraints/Expectations:

1. Downtime: Downtime should be limited as much as possible with the use of back-up equipment. The system should be up and available for use 15 hours per day.

2. Response time:

a. Document recall: A document should be retrieved from the document store and available for either terminal display or reproduction in approximately 15 seconds.

b. Output of hard copy: @ 1 second per page of output.

c. Output of microfiche: @ 2 minutes per microfiche for a 24:1 developed copy.

3. Quality:

a. Output:

(1) Hard copy: should resolve more than 200 lines per inch.

(2) Microfiche: should resolve per frame at 6,000 scan lines for COM.

b. Input - 300 lines per inch at 1 bit per pixel or 200 scan lines with 16 steps of greyscale.

4. Resources:

a. Personnel: There should be a significant drop in the personnel required to perform the document input/output function.

b. Costs: Implementation will initially cost between $7 and $10 million dollars over the next 10 years.

5. Volume of data: Approximately 1 million historical documents will be converted to digital storage with an additional 30 to 45 thousand reports added to the collection per year.

6. Geographical location of users: Centralized storage of reports at DTIC with remote display and reproduction capability remotely.

E. MANAGEMENT INFORMATION

Primary System User/s: Administrative Services

Secondary System User/s: ADP Services
User Services
Acquisitions
Reference/Retrieval
Product Distribution
Document Storage
Technical Processing
Network Services
Development Services
Other Users
SBIN Users

Purpose: The purpose of the management information system has five aspects:

1. To provide decision support capabilities for DTIC-A/AD and DTIC directors. The decision support system will have the following capabilities:

a. Produce ad hoc management reports.

b. Produce recurring management reports.

c. Answer "what if" questions (i.e. what will be the impact of a 7 percent decrease in the budget).

d. Provide an integrated office automation network capability.

2. To track the processing of requests for demand and recurring documents, bibliographies, and RDT&E data bank reports, and the input of records into all data bases. To generate reports for management. (This tracking system will be used to keep management informed as to the amount of time that it takes for requests/input to get through the system, as well as workload statistics, program and standards deviations and equipment status, backlog reports and turnaround time.)

3. To provide a billing system which will identify user charges as well as in-house charges. These in-house charges will not only include the costs for technical reports, but also the number of bibliographies or other data bank retrieval products, and the amount of time on DTIC computers.

4. To track labor hours by product types, budget code, and financial data. This tracking system will also handle major projects, minor projects, and tasks.

5. To provide statistical packages which will be used to generate information for management. This will include ad hoc as well as recurring reports.

Current System Description:

Presently, DTIC has no decision support system, in the sense that there is no fully automated package to aid managers in making decisions and to assist them in asking "what if" type questions. Ad hoc reports are prepared by combining data from manual and automated systems.

The existing tracking systems are partially automated. The systems for tracking receipts of requests and shipping actions are automated, while the system for reporting the stage of completion remains manual. The systems for tracking input to the data bases is automated in some instances.

DTIC's billing system is automated. The records of user charges (i.e. documents and telecommunications charges) are transmitted to the National Technical Information Service (NTIS) daily via magnetic tape. Users are sent information copies of their bills on a monthly basis. The information concerning services to free users is automated and available for retrieval by user code.

Labor hours are tracked through manual and automated means. DTIC inputs labor hours to DLA's Automated Payroll Cost and Personnel System (APCAPS). Input is accomplished via on-line terminals. Through APCAPS, DLA provides DTIC with a tape. This tape is provided on a payroll cycle basis and is available for the use of DTIC managers.

The financial system is operated for DTIC by DASC. Manual status reports are prepared for DTIC managers through the automated system.

The software packages currently available for statistical and graphics applications include the Statistical Package for the Social Sciences (SPSS) and BASIC. Additional statistical reports are prepared manually through data from the pipeline reporting system.

Proposed System Description:

The management information system will include a decision support system (DSS); a process tracking system; a billing system; a manpower tracking system; financial data; program/standards data; and statistical, graphics, and integrated packages. The DSS will be selected from commercially available packages. DTIC managers will want to access the system on-line interactively. They will want to use the DSS to answer "what if" type questions in such areas as personnel, budget, travel, and training. For example, they may want to ask such questions as "If there is a 3 percent cut in DTIC's budget, how will this cut impact my directorate's training and travel funds?" Convenience and availability of output products will be two important factors in gaining manager acceptance of the DSS. Desk-top terminals will make access to the DSS more convenient for DTIC managers. The DSS will provide great flexibility in terms of output reports. Managers will be able to use the DSS to prepare ad hoc as well as recurring reports.

A process tracking system will be developed to control requests from DTIC users (in-house as well as out-of-house). Requests will be coming to DTIC in various forms such as telephone, telefacsimile, Form 1, letter, on-line, as

well as recurring requests from the management data bases. These requests will address various products and services including bibliographies, documents, and recurring reports. On-line interactive access to the process tracking system will be provided. The system will be used to determine the status of a request (i.e. where it is in the pipeline). Ad hoc and recurring reports will be provided through the system.

DTIC is in the process of revising its charging system (i.e. limiting the number of free users to OSD and Congress, charging other former free users for documents requested, and applying a variable charge rate for document requests of other users). In addition, DTIC will develop a charge-out system for in-house users. This system will keep track of the time spent on DTIC's computers as well as the number of orders for products, special requests, input workloads, and requests filled. Such a system will make in-house management aware of their use of DTIC's resources. At some time in the future, DTIC management may decide to include out-of-house users in the charge-out system. Both the billing and the charge-out systems will be used to generate management reports. Access to the charge-out system will be on-line interactive, thus enabling managers to make queries and to generate ad hoc reports.

A manpower tracking system, which will track labor exception reporting in hours by budget code, will be developed. DTIC will be using this system to input into DLA's APCAPS. The new system will provide DTIC managers with tracking information on minor projects and tasks as well as the information on major projects traditionally provided by APCAPS. The system will be available on-line. Recurring and ad hoc reports will be generated by the system.

Finally, financial, statistical, graphics, and integrated packages will be used to generate reports for DTIC's managers. These packages will be available on-line. Data from the process tracking system and the manpower tracking system will be used to perform regressions and to enable management to make projections. This same data will be used by the graphics packages to demonstrate the use of resources within DTIC. Integrated packages will be used to merge graphs with text for reports. Some uses of these packages will require graphics printers and color monitors. Managers will want to be able to print graphs locally on terminals, word processors, and microcomputers as well as on the high-speed printer and the Xerox 9700. In addition, managers will want to make use of these packages to produce transparencies.

Constraints/Expectations:

1. Downtime: Due to the importance of the information included in this system, downtime should be kept to a minimum. The management data should be backed-up to disk and/or tape periodically. Arrangements should be made for a back-up computer. The computer should be available 10 to 15 hours daily.

2. Response time: 5 to 10 seconds.

3. Frequency and type of output reports:

a.	Billing reports	- NTIS	- Daily
b.	Charge-out reports	- DTIC users	- Monthly
		- DTIC in-house	- Monthly
c.	Labor exception reports	- DTIC management	- Daily/Weekly/Monthly
		- DLA	- Monthly
d.	Ad hoc reports	- DTIC management	- As needed
e.	Statistical workload reports	- DTIC management	- Daily/Weekly/Monthly/ and as needed

4. Resources:

a. Personnel: The impact on current personnel resources will be minimal, i.e. the number of personnel will remain unchanged but the terminal time per session will be reduced.

b. Costs:

(1) Decision support software

(2) Programing costs

(3) Statistical software

5. Quality: Letter quality output.

6. Geographical locations of users: DTIC, DLA, DTIC field offices, and San Diego office (MATRIS).

F. NETWORK SERVICES

Primary User/s: DTIC In-House
DTIC Remote Users

Secondary User/s: Other Government Agencies
DLA-S

Purpose: The purpose of the network services system has six aspects:

1. To provide interconnection between diverse DoD, federal, and commercial information resources and to provide standard interfaces and post-processing capabilities for use with these resources.

2. To provide additional methods of telecommunications through value-added networks, satellite communications, and state-of-the-art communications technologies which support these interconnections.

3. To provide integrated information systems within DTIC.

4. To provide alternative methods of communication through teleconferencing, electronic mail, telefax, and other services for the DTIC user community.

5. To distribute DTIC-compatible software to the user community for its local needs.

6. To facilitate downloading of information from the central DTIC data base through such media as video disc, diskette, etc.

Current System Description:

Most of the services envisioned are non-existent, under development, or scattered throughout the agency. The actions DTIC-S takes to establish DROLS users, provide access paths, and monitor these paths is the closest existing process.

Proposed System Description:

The network services system will include an interconnection between DTIC's system and other federal and commercial systems; the use of additional telecommunication technologies; an integrated information system; alternative methods of communicating with users; a means to distribute DTIC's software to users; and the capability of downloading information. The interconnection between DoD, other federal, and commercial systems will be provided through a DoD gateway. The Technical Information System (TIS) gateway developed by the Lawrence Livermore Laboratory will be used as a basis for the DoD gateway. Examples of data bases to be considered for inclusion in the DoD gateway are data bases identified through the Data Base of Data Bases Project, Dialog, BRS, Orbit, and ISI. The DoD gateway will provide users with a common command language, auto logon and logoff, postprocessing, and downloading capabilities. Users will be provided with a series of standard formats for postprocessing as well as the capability to create their own formats. Graphics capabilities will also be provided.

Additional methods of telecommunications such as value-added networks, satellite communications, and state-of-the-art communications will be part of the network services system. Access to the DTIC data base system will be provided through a variety of value-added networks such as the ARPANET, TYMNET, TELENET, and the GE Information Services. Store and forward message switching, terminal interfacing, and host computer interfacing will be some of the services provided by these value-added networks. Satellite communications will be used to further distribute the new data base. In addition, satellite communications will help to enhance the quality of the transmission of the data. State-of-the-art communications technologies will be employed where deemed feasible.

The integrated information systems will include networks of word processors and microcomputers. The network of word processors will be limited to use by in-house and field activity personnel. Networks of microcomputers will be available for use by in-house, field activity, and user personnel. The integrated information systems will need to interface with the management information system to facilitate the tracking of requests, complaints, etc.

Alternative methods of communication will be provided through teleconferencing, electronic mail, and telefax. These methods will be made available in-house as well as to the user community. Increasing use will be made of teleconferencing for SBIN meetings, user conferences, and potentially, training. In particular, teleconferencing will be used to facilitate refresher and workshop training sessions. Introduction to data base enhancements will be provided in the workshop training sessions. Electronic mail will be the preferred method of communication between DTIC personnel and the user community. Additionally, users will be able to communicate with each other through the electronic mail system. The electronic mail system and the DTIC data base system will be available on the same computer system. Telefax capabilities will enable users and in-house personnel to transmit individual work units and individual pages of technical reports to other members of the network. The integrated information systems will be able to link into these communications systems.

The retrieval software for the new DTIC data base will be distributed to interested users. Users will be able to load the retrieval software on selected microcomputers and to create local data bases which include records which are not appropriate for DTIC.

The network services system will facilitate the downloading of DTIC's data base records to local microcomputers. DTIC will provide users with the software necessary for downloading. In addition, DTIC will further distribute data base records through a new CAB program. Through this program, users will be provided with data base records on video discs or diskettes.

Constraints/Expectations:

1. Downtime: Most aspects of network technology will lessen the impact of downtime. For instance, if the software and the information being

processed are both on site, if the system goes down, only that site is affected. It may also give a user several pathways into a system, so in case one goes down, another is still available. In addition, a user could still use one of the components, such as postprocessing on a microcomputer if the main system is down.

On the other hand, network technology has the effect of increasing the number of different components in the system. If several components must be used to complete a process, downtime will be additive. For example, if each component in a two-component system is down 5 percent of the time and a process needs both, a user will not be able to complete the process 10 percent of the time.

2. Response time: 5 to 10 seconds.

3. Frequency and type of output reports: Not applicable.

4. Resources:

a. Personnel: The impact on personnel resources will be minimal.

b. Costs:

(1) Software development (gateway, common command language, postprocessing, etc.) or off-the-shelf software if available.

(2) Charge-back system for using other data bases.

(3) Equipment (computers, telefax, video disc, etc.). Some technologies such as video disc will only be cost effective with a large number of users.

(4) Telecommunications costs.

(5) Telefax - 1 to 2 percent of users.

5. Quality: There should be a minimum of noise on the line so that time is not wasted on reentering commands.

6. Geographical location of users: DTIC, DTIC field offices, DTIC users, potential DTIC users.

7. Security: Care must be taken to make sure security is maintained on the telecommunications and on downloaded information.

8. Volume of use:

a. Gateway - 50 to 60 percent of users.

b. Telecommunications:

(1) Value-added networks - 75 percent of users.

(2) Satellite communications - 1 to 2 percent of users.

c. Alternate methods of communication:

(1) Teleconferencing - 10 to 15 percent of users.

(2) Electronic mail - 80 to 90 percent of users.

(3) Telefax - 1 to 2 percent of users.

d. Distribution of DTIC-compatible software - 5 to 10 percent of users.

e. Downloading of information - 5 to 10 percent of users.

G. RETRIEVAL SYSTEM

Primary User/s: Reference/Retrieval Services
SBIN Users
Other Users

Secondary User/s: Administrative Services
ADP Services
Acquisitions
Technical Processing
Development Services
Network Services

Purpose:

To provide a user-friendly, on-line, interactive mechanism that will do the following:

1. Enable users to easily identify documents they want from DoD sources, retrieve and display the information, order documents.

2. Enable users to capture direct data from in-house prepared data bases.

3. Enable users to easily identify sources of further information.

4. Enable users to manipulate multiple parameters at once to identify information and information sources.

5. Enable users to browse through documents for specific information.

6. Enable users to manipulate data contained on-line to form new information.

Current System Description:

The present system's orientation involves creating one search statement, displaying or qualifying it, and then using that same search on other data bases. Only subject term searches may be transferred across data bases due to the lack of standardization of the numeric role codes. The results of searches are not saved to be used in conjunction with a further search. A search may be created with explicit AND and NOT Boolean operators and implicit OR operators. No parentheses are allowed, with the result that AND is always the dominant operator and the ORs are always executed first. A user may use free-text searching through the role codes but no locational searches may be done. Although most fields are directly searchable, others are not searchable, while still others may be searched only by qualifying after the fact. The present system allows hierarchy searching but neither the inverted index nor the hierarchy can be printed on-line. Right truncation is allowed although internal truncation is not.

The on-line sorting feature of the present system is rare among data base systems and the capability of producing indexes for off-line prints seems to be unique. Results of searches may be either browsed through on-line or sent to be printed off-line as a bibliography. In addition, the documents themselves may be ordered through the computer system.

Proposed System Description:

The retrieval system will use Boolean logic to manipulate stored parameters describing each record. These parameters will include descriptive information and each substantive word in any textual field, with each parameter searched by a unique, alphabetic code. The textual fields may be searched not only with the Boolean operators AND, OR, and NOT, but with locational operators which would allow the user to specify how close the words must be to be retrieved. Every field will be directly searchable in some manner. In order to make searching as easy as possible, the search methods and codes will be standardized across the different data bases. Besides textual searching, there will also be hierarchical controlled vocabulary searching. All indices (i.e. search tools) may be displayed on-line during a search to aid the choice of descriptors. Other search methods would include right and internal truncation.

The operators may be combined in any order, with parentheses surrounding certain sections to ensure that they are searched as a group. Other search statements may be included as parameters in the search. This means that the retrieval system will need the capability of saving several searches or subsets of searches for future use in a session. The orientation will be that a user will enter a data base to perform several searches, order results, then enter another data base.

Due to the nature of the materials, security must be maintained at many levels. The system must guard access to data bases, records, and fields. The index displays must mirror these accesses so that unauthorized users can not receive numerical clues to the nature of fields or records they can not see. The validation of displays or orders will take place on-line through the request processing system.

In all cases, the retrieval system will be English language oriented. Error messages and prompts should spell out messages rather than use codes which the users must translate themselves. A two-tier system for experienced versus inexperienced users would be desirable, with longer messages for inexperienced users. Similarly role codes should be alphabetic for ease of use.

Once users have selected a search set, they will be able to display the material in the computer on-line or off-line. The two modes of viewing will be parallel in capabilities and mode of operation. For security reasons, off-line ordering must include several additional parameters, such as contract number. Users will be able to select a canned format for display or use one that they create themselves on-line. They may then browse through selected records on-line. Search sets may be sorted by a number of

parameters before viewing on-line. For off-line viewing of document sets, various indexes may be ordered to allow the users to access the set by different parameters. Users may also order the documents themselves on-line with the charges deducted from their deposit accounts.

The present system also allows displaying or printing search sets and ordering documents. The proposed system, however, would use fewer numeric codes for order types and fields and would allow on-line validation of documents. The proposed system would allow canned, possibly tabular, formats which would be especially useful for postprocessing.

During any of these processes, the users may stop to receive an explanation for any command. They may also check on the amount of money they have spent during the session and what they have left for data base expenses. Comments may also be entered on-line to the data base producers. These features are not in the present system.

After the information has been retrieved from the computer, the users may manipulate the data to form new information. Computational abilities may either be built into the main system or be contained in a subsidiary system at the user's site. Other postprocessing capabilities will also be included along with the capability of storing a subset of documents from the data base for future reference. Postprocessing is a proposed feature not in the present system.

<u>Constraints/Expectations</u>:

1. Downtime: Should be limited as much as possible; the system should be available as a minimum from 0600 ETZ to 2300 PTZ, 6 days a week.

2. Response time: 5 to 10 seconds.

3. Resources:

   Personnel: There should be a minimal effect on personnel.

4. Number of users: 940 on-line retrieval users by 1986 and 2,400 by 1995.

5. Volume of records in data bases: Approximately 1.5 million by 1986 to 3 million by 1995. On-line system interrogations are estimated to approach 640,000 by 1986, an increase of about 23 percent over 1983.

6. Relations to other systems: The retrieval system obtains its records from the data input system. Whenever a display or order is entered, the transaction goes to the request processing system for validation. Request processing would then send any document orders to the document output system for printing off-line. Statistics on searching and ordering will be funneled into the management information system for future use.

7. As in the present system, there will be basically three types of terminals: synchronous dedicated classified terminals, asynchronous, and synchronous dial-up unclassified terminals.

8. Geographical location of users: DTIC and sites around the country.

H. REQUEST PROCESSING SYSTEM

Primary User/s: Product Distribution
Reference/Retrieval
Document Storage

Secondary User/s: User Services
Other Users

Purpose: The purpose of the request processing system will be:

1. To provide for centralized processing and tracking of document and bibliography orders.

2. To allow for centralized validation of:

   a. user code,

   b. deposit account,

   c. facility clearance, and

   d. need-to-know.

3. To trigger document and bibliography orders and to provide the appropriate labels, calculate postage and receipts for mailing purposes.

4. To provide a mechanism for maintenance of profiles for Automatic Distribution of Documents (ADD), Recurring Reports (RR), and Current Awareness Bibliographies (CAB), and for triggering these tailored searches at appropriate intervals.

5. To provide for flexible output formats from the DTIC data bases. This includes bibliographic format as well as physical form (hard copy, microfiche, magnetic tape, and digital signal).

6. To provide an automated system of requesting release of limited documents and maintenance of blanket release of limited data.

7. To shift the burden of file keeping and processing from costly human maintenance to the computer and to make these automated files available to both in-house users, as well as external users.

Current Process:

The goal of the current process is to handle orders for products, produce the output product, validate the user's access to services, and mail to the user. Request processing is currently scattered throughout DTIC's operational element. Document tracking is done manually with the results being tabulated by DTIC-M. Registration of users and maintenance of the DD 1540, which is used for validation, is maintained in DTIC-D. Document orders may be triggered by either on-line system users as well as Reference Services in

DTIC-D. Bibliography orders are triggered by Retrieval in DTIC-T or by on-line users. ADD, CAB and RR profiles are maintained by DTIC-T and output is produced by either DTIC-D or DTIC-S. Special output formats are prepared upon request by DTIC-S. Requests for limited documents are processed through DTIC-D. Mailing labels and receipts are produced by DTIC-S. Tapes of unclassified unlimited records are sent regularly to other federal agencies (NTIS, DOE, NASA).

Proposed Process:

When a request comes into the DTIC processing system there are three basic steps to be performed:

1. Validation of user access.

2. Triggering the order from either the on-line system or product distribution system.

3. Production of the appropriate mailing labels, autom ic calculation of postal charges and receipts.

The request processing system will be expected to unify these tasks in the most efficient manner. When problems develop along the request processing pipeline, the appropriate users (this includes internal as well as external users) are notified as to the nature of the problem, and the expected time of resolution. This could be done either through the mail or via on-line logs.

There are two basic products that are ordered through the request processing system:

1. Documents, from the document output system, which can be reproduced in either hard copy, microfiche, or electronic format.

2. Reports or bibliographies from DROLS, which can be produced in either hard copy, COM fiche, magnetic tape, or electronic format.

These products can originate as the result of a demand user request for a document or an on-line search, or as part of a recurring subscription service.

Additional modules of the request processing system will be:

1. Maintenance of user profiles for the CAB, RR, and ADD programs.

2. Tracking of all output requests and their status with the appropriate management reports.

3. Control of limited requests, production of letters, follow-up notices and maintenance of blanket release file.

4. Automatic creation of the magnetic tape for the regular release to federal agencies of unclassified unlimited documents.

5. Postal manifest that documents outgoing mail.

Constraints/Expectations:

1. Downtime: Downtime should be limited as much as possible with the use of back-up equipment. The system should be up and available for use 12 hours per day.

2. Response time:

a. Validation: A user code should be validated within 5 seconds of validation request.

b. Document request: Document orders can be queued and sent to product distribution upon request or at periodic intervals throughout the day.

c. Bibliography request: Bibliography orders can be queued and sent to the computer upon request or at periodic intervals throughout the day.

d. Limited document request: A query into the limited request system should be confirmed within 5 to 10 seconds of the request. If a letter to the releasing agency is required, these may be queued for processing at intervals throughout the day.

3. Resources:

Personnel: There should be a slight drop in the personnel required to maintain the request processing system and related modules.

4. Volume of data: Average requests per month processed throughout the request processing system:

Technical Report Document Orders:	31,000/month
Bibliographies or Reports:	
Technical Reports:	5,000/month
Work Unit :	1,000/month
Program Planning :	175/month
IR&D :	175/month

5. Geographical location of users: DTIC and DTIC field offices.

6. To gain consent of the U.S. Postal Service to use a computer-generated manifest mailing system.

I. USER SERVICES

Primary User/s: User Services
Reference/Retrieval

Secondary User/s: Acquisitions
Product Distribution
Document Storage
Technical Processing
Network Services
Development Services
Administrative Services
ADP Services

Purpose: The purpose of the user services system has six aspects:

1. To facilitate the registration of new users.

2. To provide a marketing data base which will be used in determining market sectors to penetrate and in developing a marketing strategy for DTIC.

3. To track complaints and provide follow-up information on complaints.

4. To track correspondence between DTIC users and DTIC.

5. To track reference queries and to provide follow-up information on these queries.

6. To provide alternatives to traditional training methods (i.e. classroom instruction). These alternatives may include methods such as computer-aided instruction (CAI).

Current System Description:

New users are registered through the Reference Services Branch Registration Section. A record of each registrant is stored on the MUAC file on DTIC's UNIVAC 1160. The User Services Directorate is peripherally involved in the registration process through its involvement in information and library science (i.e. ASIS and SLA) conferences. The User Services Directorate distributes registration kits at these conferences.

There is no automated marketing data base, nor is there a DTIC marketing strategy. Currently, the User Services Directorate is making strides to market DTIC's products and services to the small business community.

Currently, DTIC has no consistent means of tracking complaints, correspondence, and reference queries. All of the current means are manually oriented.

Traditional training methods, including classroom instruction and self-training manuals, are available through the Special Products and Terminology Branch. DTIC is involved in an ongoing major project to develop

a CAI system. Presently, an introductory course and a Technical Reports (TR) file course are being developed on DTIC's UNIVAC 1160 computer using the Pilot Language.

Proposed System Description:

The user services system will include a registration system; a marketing system; a complaints follow-up/tracking system; a correspondence follow-up/tracking system; a reference query follow-up/tracking system; and various training alternatives. The registration system will be automated and available on-line. Potential users will be able to log on to the registration system and complete the registration form (DD form 1540) on-line. For potential users who do not wish to take advantage of the automated system, a manual version will be available. DTIC personnel will enter the manually produced forms into the system. The registration system will be linked with the validation system. Thus, validation will be able to be accomplished on-line. The registration system will replace the MUAC file. Updates will be accomplished as necessary, and contractor registration will be reviewed annually. Statistical analysis of DTIC users will be required on an ad hoc basis, therefore, the registration system will need to be linked with the management information system.

The marketing system will make use of commercially available marketing software. Data from the registration system, the Work Unit Information System (WUIS), and commercial systems will be used to determine the market sectors which DTIC wants to penetrate. WUIS will be compared to the registration system to identify new contractors who are potential users. The marketing system will provide DTIC marketing specialists with decision support capabilities. For example, the marketing specialist may want to use the system to determine the impact of allocating resources to different market sectors.

The complaints follow-up/tracking system will be available on-line. The system will enable DTIC personnel to determine when a complaint was sent to DTIC, where it came from, where the complaint is in the organization, who is responsible for taking action on it, where it has been in the organization, what the final action was, and when it was taken. Response time will be especially important, because the users will call and ask about the status of a complaint. The system will need to be queried while the user waits. At some point in time, users may want to query the system themselves.

The correspondence follow-up/tracking system will be available on-line. In many respects, it will resemble the complaints follow-up/tracking system. Records in the system will contain information concerning where the correspondence came from, its subject, the DTIC person(s) responsible for responding, the date of the response, and the response given. As in the complaints follow-up tracking system, response time will be important. Users will want to call DTIC and make inquiries concerning the status of their inquiries. Queries will need to be made to the system while the user waits. Users may want to be able to query the system themselves.

The reference query follow-up/tracking system will be available on-line. It will resemble the complaints follow-up/tracking system. Through the system DTIC personnel and DTIC users will be able to determine the status of a reference request. The system will include information on the subject of the request, the person and activity making the request, the date of the request, the DTIC person(s) responsible for handling the request, the date the request was answered, and the answer to the request. As in the complaints follow-up/tracking system, the system will need to be queried while the user waits. Eventually users will want to be able to query the system themselves.

The training system will be used to augment the traditional methods of training such as classroom instruction. The initial training system will be based on CAI. The CAI will be developed in modules so that it will be easy to add in portions on new features. There will be beginning and advanced CAI packages. Initially, CAI will be offered through a centralized system at DTIC. Eventually the system should have decentralized capabilities, allowing access to the CAI modules on microcomputers.

Constraints/Expectations:

1. Downtime: Downtime for the user services system should be kept to a minimum. The registration system should be backed up on tape or disk. The registration and training systems will need to be up at least 15 hours daily, while the other systems will only need to be up 10 to 12 hours daily.

2. Response time: 5 to 10 seconds.

3. Frequency and type of output reports:

a. Registration forms/reports - DTIC in-house - Daily
- DTIC field - Daily
- DTIC user - Daily

b. User profile reports - DTIC in-house - As needed
- DTIC field - As needed

c. Statistical reports regarding:

(1) Complaints - DTIC management - Monthly
(2) Correspondence - DTIC management - Monthly
(3) Reference queries - DTIC management - Monthly
(4) Training - DTIC management - Semiannually

4. Resources:

a. Personnel: The impact on personnel resources will be minimal, mainly in terms of time saved rather than positions reduced.

b. Costs:

(1) Development costs

(2) Software (marketing, word processing, CAI)

5. Quality: Letter quality output for reports.

6. Geographical location of users: DTIC, DTIC field offices, DTIC users, potential DTIC users.

SECTION 3

Information Industry and Technology Forecast

This section is based on an Arthur D. Little, Inc. report to NBS entitled "Effects of Future Information Processing Technology on the Federal Government Situation." The report addresses ADP technology projections through 1995. Two apropos sections germane to DTIC are:

A. Anticipated changes in the information industry and market.

B. Model general-purpose computer systems of the future.

A. ANTICIPATED CHANGES IN THE INFORMATION INDUSTRY AND MARKET

Most important in terms of overall market growth has been the acceptance of improving network technology in business data processing. Some organizations have employed interactive systems with networks of terminals for many years. Only recently, however, have the improvements in several hardware and software technologies combined to produce products that make data processing networks attractive to the majority of users. Great increases in the markets for network-related products have resulted (terminals, controllers, distributed mini-systems). They have taken over work that if done, would otherwise have been done by central mainframes. As a result, the traditional mainframe market has recently grown more slowly than the market for network-related products.

Microprocessors have increasingly been used instead of custom-designed integrated circuits to save design cost. This has led to the distribution of control software among the various elements of a data processing system, a decomposition of earlier monolithic computer systems into groups of "intelligent modules." Such groups of intelligent modules also offer advantages in failure resistance, incremental system growth, and custom tailoring of functions. During the mid-1980's, the traditional computer system itself will become a group of modules, differentiated from the communications net only by the presence of very high-speed inter-communications among the modules and a supervisory processor to direct the operations of the group. Each module will contain the software appropriate to its function; the monolithic operating systems characteristic of present computers will be largely decomposed into functionally specialized units.

Past cost and technical limitations of high-speed communications have constrained the growth of data and text processing networks, and virtually precluded both high-speed image networks (teleconferencing and facsimile) and interactive consumer services. This cost is dropping for several reasons. Most importantly, common carrier organizations all over the world are upgrading their facilities, a process that will take many more years. Progress has been accelerated for specific services by incorporating more hardware and software "intelligence" in the devices that send and receive data. For example, facsimile transmission becomes faster as more advanced bandwidth compression logic is incorporated in transmitters and receivers, and both TV and FM broadcast stations can transmit data in unused time slots to suitably equipped receivers. Finally, satellite communications can provide point-to-point high-volume communications via synchronous satellites. The costs are still high but will come down as volumes rise.

B. MODEL GENERAL-PURPOSE COMPUTER SYSTEMS OF THE FUTURE

Future general-purpose systems will be bus oriented (a bus is a wideband communications line). There will probably be two physically separate buses in most systems: a very high-speed bus for transmitting data and programs (probably a fiber optic bundle), and a control bus for transmitting brief control messages between processors (see figure 1). It will contain multiple computers dedicated to specific functions of the system. The specific

function of each processor (e.g. the programing language to be processed) will usually be determined by alterable microcode.

There will no longer be a single, shared storage serving all the processors. Instead storage will be dedicated to individual processors or clusters. Clustered processors will be used where multiple processors should work on a single data stream, either to provide failure tolerance or to dynamically share workloads of varying priorities. Such clustered processors will typically be used for input/output processing, for file processing, and for specialized computing tasks where arrays of processors can be applied in parallel to tasks like image manipulation.

A supervisory processor will always be present. Containing redundant small computers (to guard against internal failure), it will be responsible for measuring overall system performance and for sensing and diagnosing equipment failures.

An input/output processor will also be present. Its size and nature will vary widely, but it will usually be capable of controlling the attached communications lines and of switching messages between terminals (whether they contain data, text, or digitized imagery or voice). A file processor will usually be present to perform access control, management, and retrieval functions.

By the mid-1980's, distributed processing should be universal in some form. However, there are two constraints governing the extent to which distributed processing is employed.

1. File Management and Control - If a file record is to be altered by more than one party, carefully developed systems to assure identity of records at multiple locations must be employed. The distribution of files in a processing network must therefore be planned and controlled on a central basis if integrity is to be assured, along with the distribution of data entry, inquiry, and processing functions associated with the files. Other constraints on file distribution include access control, security, backup, and recoverability.

2. Non-Standard Communication Protocols - There is no standard protocol by which information processing devices communicate with one another. Computer and office system manufacturers promote their own, hoping for competitive advantage. Users, forced to proceed with the implementation of network systems, develop their own protocols or select those of particular manufacturers. The ISO standards for message communication should eventually become universally supported, however.

The modularity of future systems may have the greatest impact on cost effectiveness. Systems employing modular computers in distributed networks need never be replaced as a whole. They will be able to evolve, module by module, as users' needs change and as new capabilities become available. After 1990, it should never be necessary to replace such systems in their entirety, as was the case with past computers: life cycles will become

indefinitely long. For this to be true, the users' programs and data bases must be machine independent, however, capable of being moved from one module to another.

Users would also like to be able to transport their programs across product lines; to be able to select among competitive vendors' offerings for every system module without having to reprogram existing software. Vendor independence cannot be guaranteed unless a comprehensive set of universally supported standards exists. Some standards exist now and others are slowly emerging, but the process is slow because of its inherent complexity and manufacturer self-interest.

After 1990, users of information systems will in most cases communicate with them directly to specify their needs and receive results, rather than through operators. This will be true whether the need is for an answer to a question, for a routine batch processing run, or for entry of data or messages. Much progress has already been made in software to support the required dialogs with relatively untrained users, and much more can be expected in the future. By the early 1990's, it is reasonable to expect that network systems will be available that can handle voice and digitized image material as well as data and text, that can assist the users in discovering and using system resources, and that can control themselves within the bounds of normal operations:

- compensating for equipment failures;
- optimizing service levels to meet fluctuating demand in accordance with established priorities;
- supporting multiple levels of security and access control; and
- measuring the use of system resources and identifying bottlenecks.

For data entry applications, improvements through 1985 will mostly come from improved methods of key entry: from software-supported applications that provide operators with selections among prestored items or permit operators to fill in the blanks in standard messages, thereby reducing the number of keystrokes required. Beyond 1985, voice data entry will become superior to key entry for applications where vocabulary and syntax can be restricted. Direct input of sensor data may also be helpful in data entry. Since most kinds of sensor data can be digitized at the source and processed digitally, it is possible in some cases to transmit sensor data directly or via magnetic storage to an information system. If human review and validation are necessary, it can be provided via display on an interactive terminal without reentry being needed.

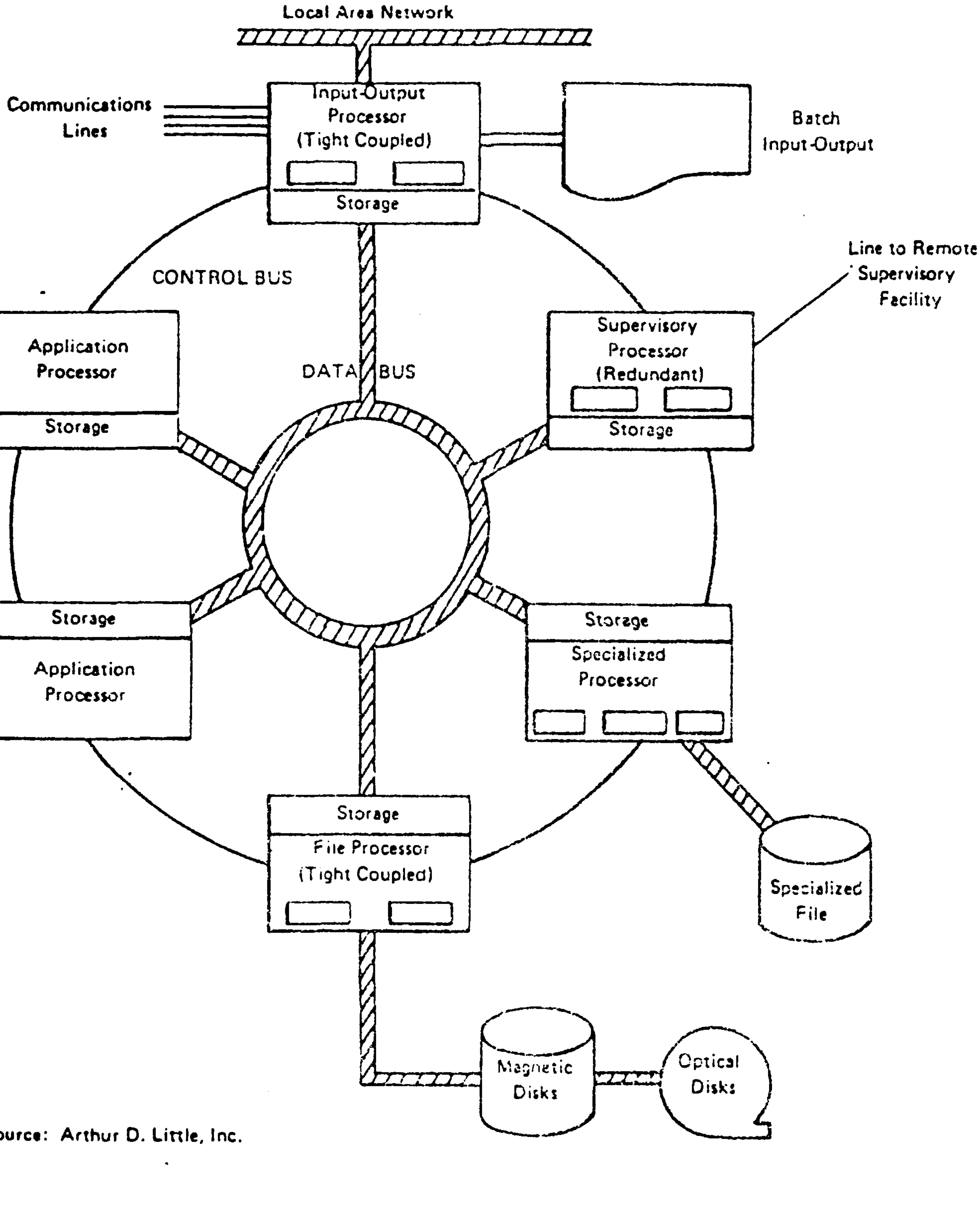
The number of formal programing languages in general use will increase somewhat as the strong-data-typing languages initially developed for minicomputers (primarily PASCAL and Ada) come into widespread use. The conventional COBOL, FORTRAN, and PL/1 will continue in use, but will evolve in the directions of modularity and data independence.

After 1985, the end users of the new systems will do much of their own programing via interactive dialogs with easy-to-use software, so the need for application programers will be reduced proportionately. However, user organizations will need central groups of highly trained technicians to establish the environment in which the end users work: to select the hardware and systems programs, to establish the standards, to define the software tools available to the users. The emphasis will be on personnel quality rather than quantity: to support a constant pace of application development, fewer application programers will be needed, but a cadre of experts will be required whose technical knowledge may be greater than presently needed. (After 1990, this requirement for technical expertise may relax as the system modules become more and more automatic.)

A training requirement for the end users is implied, if they are to do their own programing. This requirement should usually be met by short (1/2- to 3-day) courses, since the interactive software selected will probably include self-teaching and assistance facilities.

Operations personnel requirements should slowly decline: system modules of all types should become increasingly automatic in operation, requiring less loading of programs, scheduling, changing of media, etc. Data entry requirements should also slowly decline by reduction in keystrokes through 1985, and by constrained voice data entry after that.

FIGURE 1



Source: Arthur D. Little, Inc.

FUTURE GENERAL-PURPOSE COMPUTER SYSTEM

SECTION 4

ADP Configuration

A. Scope

B. Assumptions

C. ADP Functional Requirements Summary

D. ADP System Configuration Description and Analysis

E. Configuration Cost Estimates

A. SCOPE

The purpose of this section is to acquaint the reader with broad alternatives that support a justifiable DTIC course of action, i.e. ADP strategy. To simplify understanding and to facilitate the analysis and evaluation of system alternatives, three broad yet significantly different configurations were considered. These three configurations represent both contemporary and future philosophies and provide sufficient contrast to allow identification of advantages and disadvantages of each and quantification by cost. The three configurations are: centralized data base centralized processor (configuration 1), a philosophy similar to the present DTIC configuration; centralized data base distributed processor (configuration 2), a configuration utilizing a local area network; and distributed data base distributed processors (configuration 3). Other evaluation criteria such as performance, ease of implementation, maintenance, and user satisfaction are discussed.

It is beyond the scope of this section to lay out a preferred configuration replete with detailed justifications, although it is recognized that each broad configuration can be permuted into numerous variations stylized to satisfy DTIC's unique needs of the future. This should be the subject of a sequel system analysis effort.

B. ASSUMPTIONS

To ensure that DTIC's future plans, and especially this ADP strategy report, track with state-of-the-art endeavours and most importantly, with industry information usage patterns and situations, assumptions regarding ADP technology trends and the future of information gathering and dissemination as related to DTIC over the next decade follow. The ADP technology assumptions are based on the Arthur Little report prepared for the National Bureau of Standards, whereas the DTIC assumptions represent a composite viewpoint of the ADP strategy committee members.

1. DTIC Assumptions

a. DTIC will continue to expand its central role in the DoD STI program and act as a hub for DoD STI needs; nevertheless its basic responsibilities to acquire, store, retrieve, disseminate, utilize, and enhance information for research and engineering managers, scientists, engineers, marketing specialists, and DoD and industry planners will continue.

b. Available resources, particularly personnel authorizations, will not expand from present levels. There will be:

- continued budget constraints throughout government,
- stress on the elimination of duplication of services,
- increase of cooperative efforts between agencies,

- o development of less labor-intensive methods of operation, and
- o increased use of contractor personnel within DTIC.

c. DTIC will shift emphasis to provide products and services that are:

- o user oriented,
- o available on-line or through on-line access,
- o compiled from more than one data base,
- o self-help oriented, and
- o improved in quality and timeliness.

d. DTIC will continue to provide on-line access to classified material through the secret level. The overall percentage of classified material should rise somewhat because of the impact of the new Executive Order on national security which changes the criteria for initial classification and eliminates limits on the duration of the classification.

e. Input will be accepted in differing media. In the near term, paper copy will dominate with microfiche used sparingly. By 1990 this should change to where a large portion of input should be via digital means with paper use reduced and microfiche continuing to be used sparingly.

f. Document submittal rate will increase resulting from changes in the Defense Acquisition Regulation (DAR) from 30,000 presently to 45,000 by 1988.

g. An active DTIC marketing program will increase awareness of DTIC products and services and generate growth in the number of DTIC users. As the use of terminals in the workplace increases, DTIC will move toward serving smaller groups or suborganizational elements. It is estimated that there will be 5,000 users by 1986 (almost double present figures), and many users will have access to and be capable of operating on-line terminals. Considerable growth is expected in the number of dial-up input terminals by 1988 with adequate recovery software available for terminals operating in that mode. The number of dial-up output terminals is expected to grow fourfold to nearly 2,000 terminals between now and 1995, whereas dedicated terminals should grow to 400 in the same time span. There will be a proliferation of mini and microcomputers within the user community. Twenty-five percent of the on-line terminals will be microcomputers with significant local processing capability by 1986. By 1990 this figure should be doubled.

h. Marketeers, planners, managers, and associated analysts will comprise more than half of the user population by 1988. State and local government organizations/users will increase as availability of Federal Emergency Management Agency technical information and information on

unclassified technology applicable to public sector problems at the state and local level increases. DTIC will service more end users directly but will continue to serve intermediary users such as librarians and technical information specialists. The information requirement of users who are managers, analysts, librarians and bench-level scientists will vary and all will continue to be valid users.

2. Systems Assumptions

a. Through the use of distributed processing principles, computer systems will evolve into networks of interconnected modules, each dedicated to a particular system function (e.g. application processing, data base processing, communication control). This will have great impact on cost effectiveness. Systems employing modular computers in distributed networks need never be replaced as a whole. They will be able to evolve, module by module, as users' needs change and as new capabilities become available.

b. File processors and back-end data processors will become more widely used. As a result, higher throughput from the central processor and greater ease of use will occur because the file control functions can be separated from user programs and performed in an automatic manner.

c. Bus-oriented system architectures will predominate. The modules in the system will perform a variety of specialized functions, largely determined by microprograms in control stores associated with each module.

d. By 1990-1995, automatic load balancing, error recovery, and system optimization will be standard features of most manufacturers' software. Information processing networks which contain equipment and software from multiple vendors will be common.

e. Although communication costs are dropping rapidly, they will decrease less rapidly than other ADP. In the future, telecommunication charges will emphasize volume of data transmitted and deemphasize distance charges.

f. The dominant mode of inputting will remain the keystroking of information via terminal keyboards. Image recognition improvement has been seen with patterns with greater degrees of freedom, higher content complexity, and noise factors continuing to present major problems.

g. Little change in output technology is expected - cathode ray tubes (CRTs) are expected to maintain their dominance in the display field. Little further improvement in impact printing technology will occur, although nonimpact technology will improve steadily in both resolution and cost.

h. Fewer highly trained people should be needed in the future. Users will do more of their own programing, systems will operate more automatically, and both data entry and system maintenance will be performed by less skilled personnel. End users of the new systems will do much of their own programing via interactive dialogs with easy-to-use software. The

need for application programers will be reduced proportionately. User organizations will need central groups of highly trained technicians to establish the environment in which the end users work: to select the hardware and systems programs, to establish the standards, to define the software tools available to the users. The emphasis will be on personnel quality rather than quantity.

i. Storage technology advancements will drive data storage costs down. Advances in mass storage technology, particularly in magnetic bubbles and optical video disks, will permit larger volumes of nonvolatile removable storage to be put on systems of all classes. Noncoded information such as video signals, pictures, documents in facsimile form, and voice recordings will occupy large amounts of available storage in the future.

j. Modern operating systems such as UNIX, developed for small computers, provide features that facilitate interactive processing. Operating systems used with mainframe processors reflect past needs and tend to be more batch processing oriented.

k. The number of formal programing languages in general use will increase somewhat as the strong-data-typing languages initially developed for minicomputers (primarily PASCAL and Ada) come into widespread use. The conventional COBOL, FORTRAN, and PL/1 will continue in use, but will evolve in the directions of modularity and data independence.

l. Major enhancements are expected to occur in the program development process. For both conventional and new languages such as PASCAL and Ada, programer "workstations" will be perfected which contain a series of program assist tools including compilers, syntax checkers, text editors, project management tools, data bases, and data dictionaries in a single integrated environment. These workstations will operate with any of the major programing languages. Most written documentation and instructional material will have been replaced by audiovisual material stored on optical video disks.

m. Data base management systems will become more capable and will be able to be integrated into distributed data base systems in which data is either geographically segmented or, if there is any data duplication, centrally updated.

C. ADP FUNCTIONAL REQUIREMENTS SUMMARY

The following criteria from the Functional Requirements Section (section 2) summarize the future overall ADP system design requirements.

1. Integrated data base to minimize file/data redundancy and storage requirements and maximize file access efficiency.

2. Flexibility/portability to add or delete additional processing capacity anywhere in the system with little or no increase in personnel costs and with minimum hardware incremental costs or lost time. System should be capable of adapting to changing environmental conditions easily.

3. Processing capability to support a wide range of user services such as word processing, teleconferencing, gateways, intelligent copiers, graphics, time sharing, etc., without noticeable system degradation.

4. Reliability and integrity to ensure continued satisfactory operation when components fail or during peak operating periods.

5. Simplicity to maximize user confidence and satisfaction through ease of system operation and maintenance.

6. Hardware/software/procedural controls to ensure adequate system security and processing integrity.

7. Predictable reasonable interactive response times to minimize peaks and valleys caused by high-use periods.

8. Reduced operational/maintenance/development costs in both systems and communications.

9. Utilization of low-cost processors to take advantage of recent ADP technology and lower costs.

10. Compatibility to interface with existing in-house systems to facilitate time-phased orderly evolutionary implementation.

11. Acceptability to accommodate stated functional requirements of users easily and within reasonable time limits.

12. Development and retention of a competent, productive in-house professional staff to develop/maintain and monitor the operational system. System development has a finite life cycle. Future system tuning, maintenance, and changes are ongoing and inevitable. Personnel not familiar with system design cannot perform the above tasks effectively.

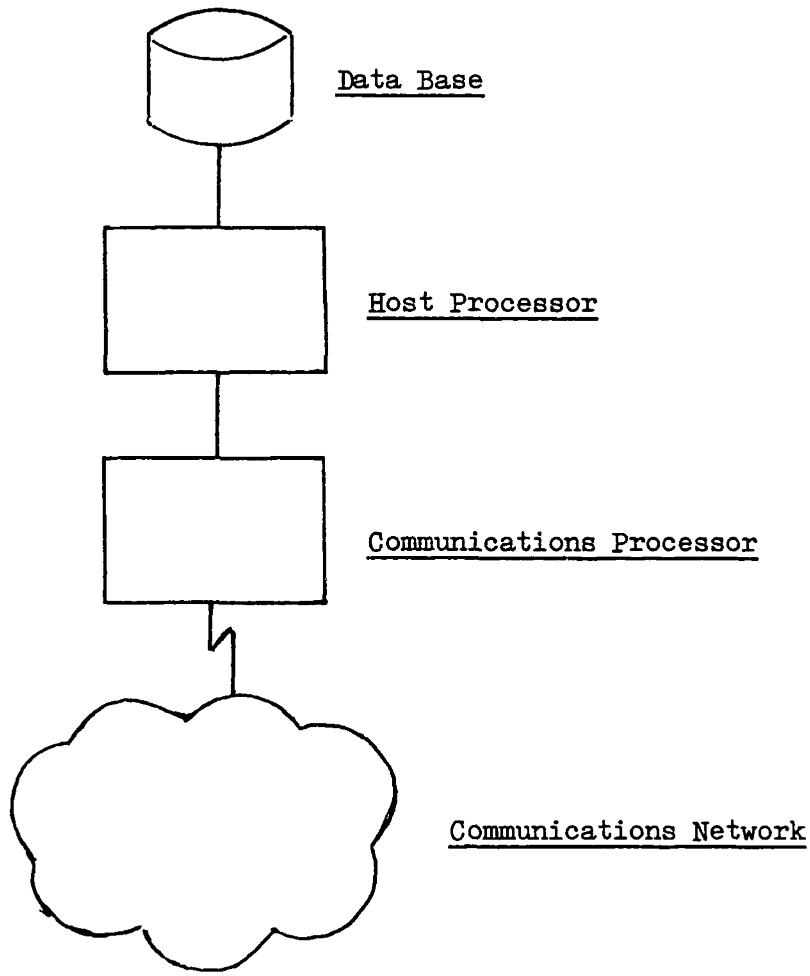
D. ADP SYSTEM CONFIGURATION DESCRIPTION AND ANALYSIS

Three broad variations of ADP configurations are presented as possible approaches to DTIC's future ADP solution. Each satisfy the functional requirements and ADP system requirements previously discussed. The three configurations are:

1. Centralized Data Base/Centralized Processing

Configuration 1, the integrated data base, is centralized and controlled by a data base management system (DBMS). The system's processing hardware consists of a general-purpose mainframe and a front-end communications processor (FEP). The information retrieval and data input functions are performed by the mainframe. The communications function is performed by the FEP. Remote users access the system over dedicated telephone lines or via a packet-switched network, e.g. TYMNET. Figure 1 depicts the centralized data base/centralized processing configuration.

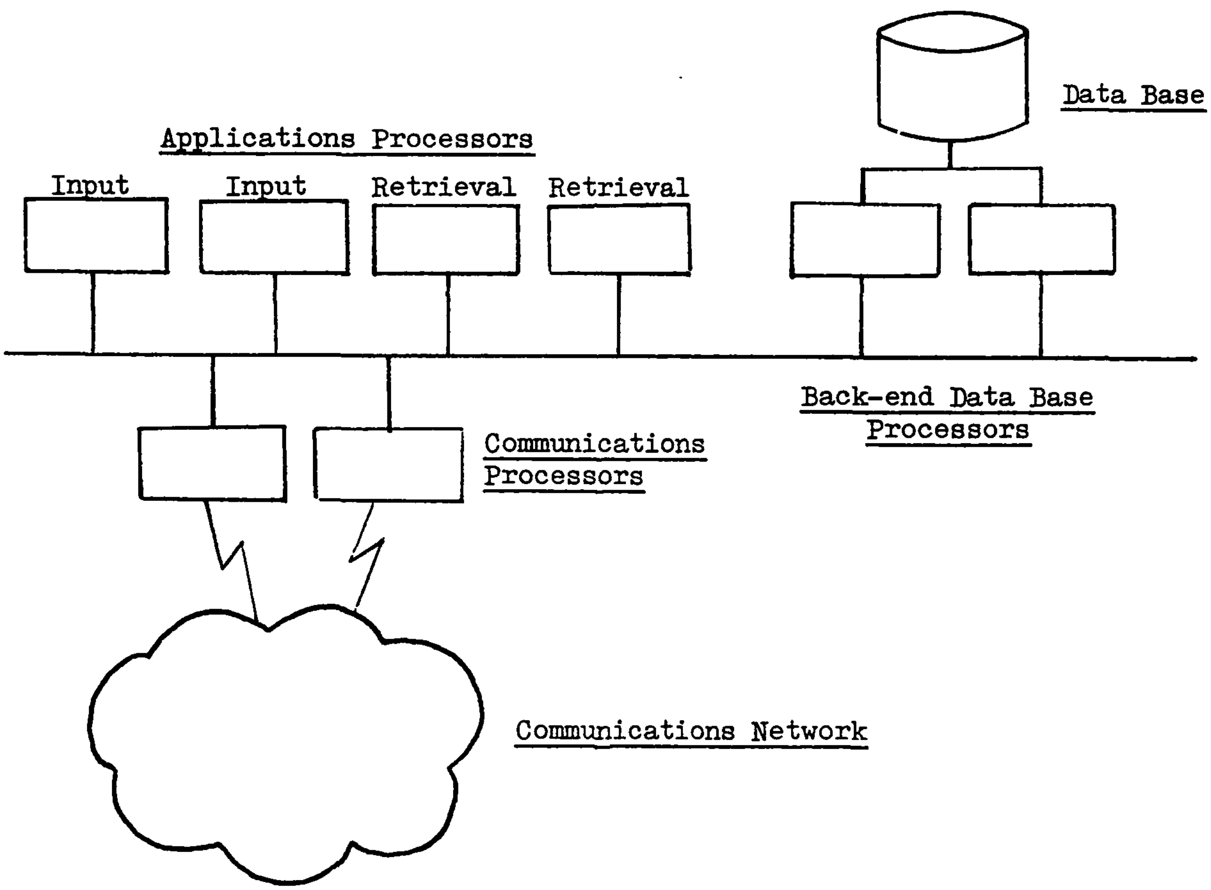
FIGURE 1



2. Centralized Data Base/Distributed Processing

In this configuration the integrated data base is centralized and controlled by data base machines. Other processing hardware includes multiple application processors, data input processors, and communications processors. The application processors provide a user dialogue, user validation, data base transaction formatting, and the formatting of search results. The data base machines maintain the physical data base and process user searches. The data input processors provide the user dialogue, input edit and validation, and duplicate checking required for the input function. These processors are connected by a baseband local area network (LAN), such as Ethernet located entirely within DTIC. The system is configured to use redundant processors to improve reliability and increase system parallelism. Remote users access the system over dedicated telephone lines or via a packet-switched network. Figure 2 depicts the configuration just described.

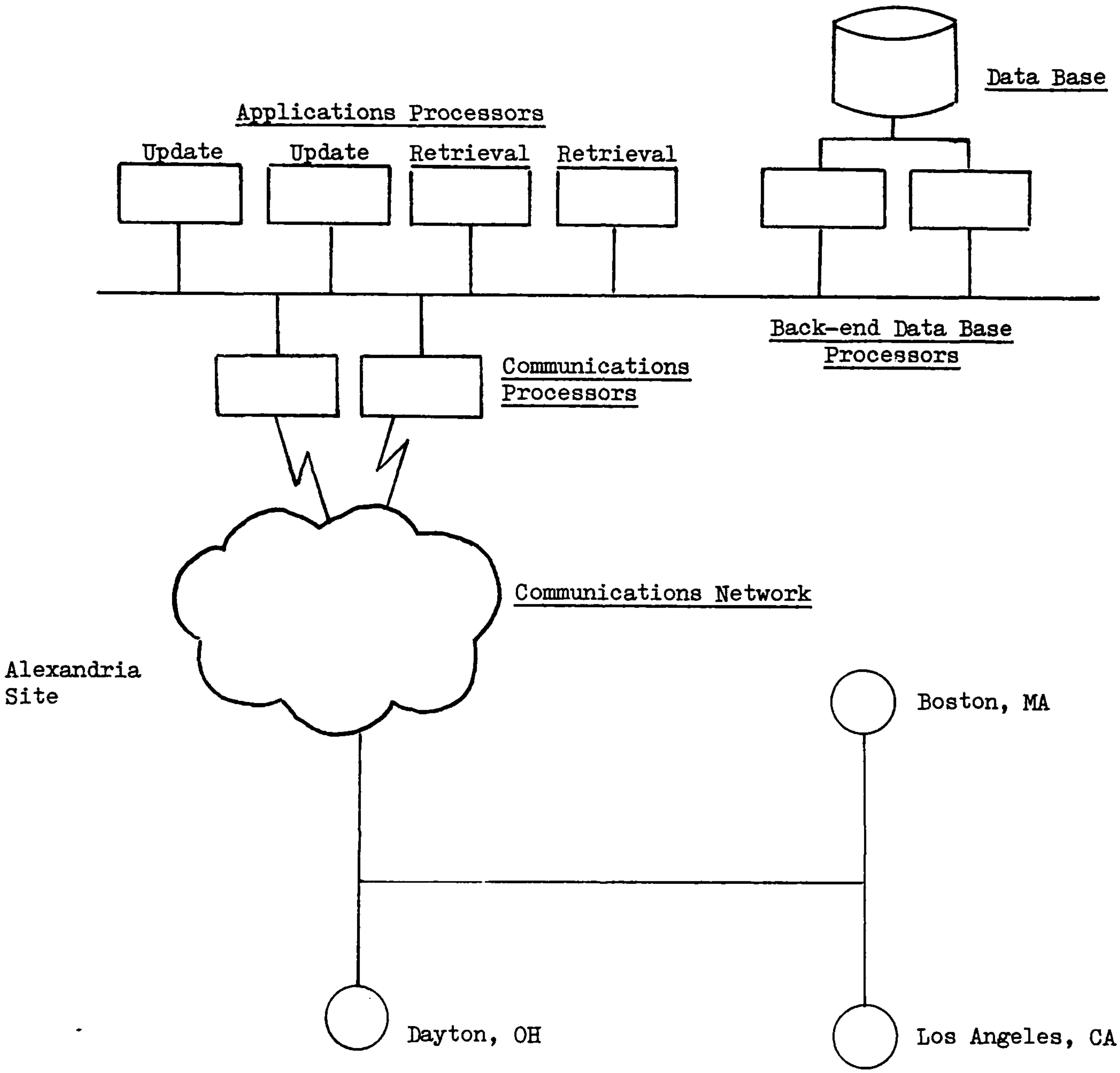
FIGURE 2



3. Distributed Data Base/Distributed Processing

This configuration is essentially the same as the centralized data base/distributed processing configuration except it is replicated at four sites geographically dispersed within the United States. Each distributed site is connected to the central DTIC sites via a dedicated 2400 baud line. This line will be used for file maintenance primarily. Figure 3 depicts this system configuration.

FIGURE 3



4. System Configuration Analysis

	Centralized Data Base/ Centralized Processing Configuration 1	Centralized Data Base/ Local Distributed Processing Configuration 2	Distributed Data Base/ Distributed Processing Configuration 3
1. Integrated data base (to minimize file redundancy and storage requests and maximize file access efficiency).	o Data is contained at single site under control of a single data management software package.	o Data is contained at single site under control of a single data management software package.	o A complete duplicated data base is located at each distributed processing site. Since the data bases are replicated, a backup capability exists in emergencies or in overloads for dial-up users. Because of need for KGs, classified backup is not available. The major problem is ensuring duplicate, current, and synchronized data bases at each of the sites.
2. Flexibility/portability (the capability of adapting to environmental changes easily. Ease of adding/deleting modules/equipment).	o Large processors tend not to be modular in design, hence incremental additions to hardware capacity are difficult and costly. Typically software developed for large processors is not portable to systems of smaller capacity without severe processing degradation.	o Small processors tend to be modular in design making it relatively easy to increase system capacity. Software for small processors is typically portable.	o See No. 2, configuration 2.
3. Powerful processing capacity (the capability of performing a wide range of services without severe degradation).	o Mainframes provide the capacity and capability to process a wide range of services, however, when I/O is excessive, the capacity/capability quality is diluted through user contention for all resources, I/O, CPU, etc.	o Typically, mini/microprocessors cannot provide the power of a mainframe, but this gap is disappearing. Multiple small processors netted together for a heavy I/O application offer advantages over a single large processor in addition to significant cost savings. These advantages include	o See No. 3, configuration 2.

	Centralized Data Base/ Centralized Processing Configuration 1	Centralized Data Base/ Local Distributed Processing Configuration 2	Distributed Data Base/ Distributed Processing Configuration 3
3. (cont'd)		modular/incremental designs, powerful specialized processing, multiple data paths, and ease of implementation.	
4. Reliability and integrity (to provide continuous satisfactory system operation at all times).	o In a single node configuration failure due to natural disasters, power outage, or hardware/software components brings down the complete system.	o In a distributed local area network configuration failure due to natural disasters or power outage will bring the system down but hardware or software failure to an individual processor will not. o Because of the low cost, redundant processors can be considered for critical function backup. o Redundant processors increase reliability. If a single processor fails, the system continues to operate at the same or lower performance level.	o Multiple data storage and processing sites reduce the scope of total system failure. Failure of a single node does not incapacitate the entire system. o Use of redundant processors increases each site's reliability.
5. Simplicity (to maximize user confidence through ease of system use).	o System simplicity is enhanced by locating the data and the processing at a single site. o Mainframe software is typically not modularized. Therefore, software change may be difficult to implement. o Single data base simplifies maintenance.	o Central site data storage and processing increases simplicity. o Multiple processors require modularization of system functions which simplifies system modification.	o Multisite processing and data storage increase system complexity. o Multiple processors require modularization of system functions which simplifies system modification.
6. Hardware/software/procedural control (to provide adequate controls to ensure system/processing security/integrity).	o Physical security easily implemented. o Control procedures and standards easily implemented.	o Physical security easily implemented. o Procedures and standards more difficult to implement and control.	o Physical security more difficult to implement. o Uniformity and standards difficult to enforce.

	Centralized Data Base/ Centralized Processing Configuration 1	Centralized Data Base/ Local Distributed Processing Configuration 2	Distributed Data Base/ Distributed Processing Configuration 3
7. Predictable interactive response times (to provide reasonable response times with minimal peaks and valleys.	o User contention during demand peaks degrades response times. o The incompatible goals of full processor utilization and adequate response times necessitate an extensive tuning effort.	o Easy to reconfigure system to address changes in user activity. o Additional incremental capacity easily implemented.	o Because of less traffic, inquiries should receive faster response times (less contention). o Additional incremental capacity easily implemented. o Full utilization of any single processor inconsequential.
8. Reduced operational maintenance/development costs.	o Personnel economies of scale - centralized staff. o System tuning expensive.	o Personnel economies of scale. o Relatively little system tuning required (cheaper to buy additional capacity).	o Storage costs relatively high (duplication). o Duplicate on-site personnel. o Relatively little system tuning required.
9. Utilization of low-cost processors (to take advantage of new state-of-the-art technology).	o Utilizes FEP for communication control. Allows protocol versatility.	o Utilizes mix of mini/microprocessors, LAN technology, back-end data processors, and network processors.	o See No. 9, configuration 2.
10. Compatibility (to provide ease of interface with other vendor equipment/ software).	o Interface standards between vendors is weak but projected to improve over the next several years. Typically, within each vendor line a full range of compatible equipment and software exists.	o See No. 10, configuration 1.	o See No. 10, configuration 1.
11. Acceptability (to meet functional requirements of users/systems).	o Continuation of current system philosophy could require no major DTIC commitment or expense.	o Implementation of a DDP would require a firm DTIC commitment, a personnel skill update, and reorientation.	o See No. 11, configuration 2.
12. Development and retention of a competent, productive in-house staff.	o The technology of alternative 1 is behind state-of-the-art. Top professionals not attracted - no challenge, no future.	o LAN and modular system technology at state-of-the-art level. Top professionals attracted to challenge and future.	o Distributed technology at state-of-the-art. Competent and productive professionals would be attracted to challenge and future.

E. CONFIGURATION COST ESTIMATES

To scope this section to manageable proportions for purposes of this report and still show meaningful cost relationships, only equipment needed to perform retrieval and update functions for the three configurations is included.

Each of the three was costed using the following criteria: equipment, equipment maintenance, telecommunications, personnel, site, and software developer costs over a 5-year period with present value factors indicated. Admittedly the costs are soft, but they are based on current schedules and price quotes using previously stated assumptions and/or "educated guesses" for traffic volumes, equipment types, etc. Software development is particularly soft and represents only the development cost of creating new update and retrieval software. These estimates were provided as "best guesses" by DTIC-S. A conservative estimate of the cost for totally new system software would be an order of magnitude more and could probably be done in about the same time frame as the search and update given adequate resources. Secondly, the telecommunication costs are the most significant costs in all three of the configurations. These costs were shown as total system costs regardless of who pays them, DTIC or the user. In the current DROLS, dedicated line costs are paid entirely by the dedicated users whereas DTIC pays "backbone" costs of the Telenet system used by dial-up users. Regardless of the accuracy of these costs they show a relative magnitude when comparing one alternative to another. This cost comparison can be useful in selecting the proper course of DTIC action.

CONFIGURATION	COSTS/YEAR ($000) 1	2	3	4	5	CONFIGURATION LIFE CYCLE COSTS	LIFE CYCLE COST PRESENT VALUE
<u>Configuration 1</u>							
Equip. Costs	2916						
Equip. Maintenance	88	88	88	88	88		
Telcommunications	1130	1130	1130	1130	1130		
Personnel	488	488	488	488	488		
Site Cost	-	-	-	-	-		
Software Development	99						
Total	4721	1706	1706	1706	1706	11545	10129
<u>Configuration 2</u>							
Equip. Costs	833						
Equip. Maintenance	45	45	45	45	45		
Telecommunications	1130	1130	1130	1130	1130		
Personnel	394	394	394	394	394		
Site Cost	-	-	-	-	-		
Software Development	77						
Total	2479	1569	1569	1569	1569	8755	7453
<u>Configuration 3</u>							
Equip. Costs	1416						
Equip. Maintenance	115	126	126	126	126		
Telecommunications	800	800	800	800	800		
Personnel	497	497	497	497	497		
Site Cost	51	21	21	21	21		
Software Development	81						
Total	2960	1444	1444	1444	1444	8736	7538

EQUIPMENT COST CONFIGURATION 1

EQUIPMENT	DESCRIPTION	COST $(000)
Host Processor	dual processor mainframe, 4 M bytes of memory, 4.5 MIPS; U1100/82 or equivalent	2400
Communications Processor	single minicomputer, 4 M bytes of memory, supports 152 synchronous/asynchronous lines, 10 MB disk; DCP40 or equivalent	478
Storage	2.7 gigabytes (1.5 million records; 1800 bytes/record) at mid-1980's costs ($14 per MB);1/	38
Total		2916

1/Cost projections taken from Design and Strategy for Distributed Data Processing by James Martin.

EQUIPMENT COST CONFIGURATION 2

EQUIPMENT	DESCRIPTION	COST $(000)
Host Processor	five single processor minicomputers, 1 MB memory each, .72 MIPS, supports 12-16 DBMS users; DEC VAX 11/750 or equivalent	335
Communications Processor	two minicomputers, each with 1 MB memory supporting 13 asynchronous and 63 synchronous lines; DEC PDP 11/44 or equiv.	258
Back-End Processors	two minicomputers each with 2 MB memory, capable of 10 MIPS and able to manage up to 10 gigabytes of data, 4096 users, 64 host systems, 30 transactions per second; Britton-Lee IDM 500/2 data base machine or equivalent	170
Storage	2.7 gigabytes	38
LAN	one high-speed baseband local area network interface for each processor; Ethernet or equivalent	32 1/
Total		833

1/ Cost from "Communication News," October 1982.

EQUIPMENT COST CONFIGURATION 3

EQUIPMENT	DESCRIPTION	COST $(000)
Host Processor	16 dual processor microcomputers, 1 MB memory each, each supporting four users; ONYX 8002A or equivalent	368
Communications Processor	8 minicomputers, each with .5 MB memory supporting four asynchronous and 16 synchronous lines; DEC PDP 11/24 or equivalent	304
Back-End Processors	8 minicomputers, each with 1 MB memory, capable of managing up to 10 gigabytes of data, 4096 users, 64 host systems, 30 transactions per second; Britton-Lee IDM 500/1 or equivalent (note the machine is slower than IDM 500/2 by up to an order of magnitude); IDM 500/2 includes a "data base accelerator"	480
LAN	one high-speed baseband local area network interface for each processor; Ethernet or equivalent	112[1/]
Storage	4 sites; 2.7 gigabytes each	152
Total		1416

[1/]Cost from "Communication News," October 1982.

EQUIPMENT MAINTENANCE COSTS
CONFIGURATION 1

EQUIPMENT	EXPLANATION	COST ($000/YEAR)
Host Processor	maintenance cost based on actual U1100/82 maintenance costs	58
Communications Processor	maintenance cost based on actual DCP40 maintenance costs	29
Storage	estimated by reducing current IBM 3380 disk maintenance costs by a factor equal to the projected reduction in mid-1980's storage costs	1
Total		88

EQUIPMENT MAINTENANCE COSTS
CONFIGURATION 2

EQUIPMENT	EXPLANATION	COST ($000/YEAR)
Host Processor	maintenance costs for 5 DEC VAX 11/750's 1/	13
Communications Processors	maintenance costs for 2 DEC PDP 11/44's 1/	12
Back-End Processors	maintenance costs for Britton-Lee IDM 500/2's 2/	19
Storage	see configuration 1 explanation	1
Total		45

1/ Datapro Reports on Minicomputers

2/ Britton-Lee Inc.

EQUIPMENT MAINTENANCE COSTS
CONFIGURATION 3

EQUIPMENT	EXPLANATION	COST ($000/YEAR)
Host Processor	maintenance costs for 16 ONYX C8002A microcomputers1/	32 (1st yr.) 43 (subsequent years)
Communications Processors	maintenance costs for 8 DEC PDP 11/24 microcomputers2/	21
Back-End Processors	maintenance costs for 8 Britton-Lee IDM 500/1's3/	58
Storage	see configuration 1 explanation	4
Total		115 (1st yr.) 126 (subsequent years)

1/Onyx Systems, Inc.

2/Datapro Reports on Minicomputers

3/Britton-Lee Inc.

TELECOMMUNICATIONS COSTS

	Charges/Year ($000)			Total
	Dedicated Line	Dial-up	Update	
Single Site (configurations 1 and 2)	1097	33	-	1130
Multisite (configuration 3)	735	25	40	800

a. The dedicated line and update charges shown assume a less than 10 percent increase in the number of dedicated users by 1986. These charges are based on the current FCC AT&T tariff #206. No attempt has been made to project future rates because of the uncertainty generated by the AT&T divestiture scheduled for January 1984 implementation.

b. The dial-up charges assume a 23 percent increase in traffic and a 22 percent increase in users by 1986. The charges are based on the FCC TYMNET Tariff #2.

c. Update charges are for the dedicated lines connecting the Cameron Station site with the three remote sites. These lines will be used for the transmission of data base updates.

PERSONNEL COSTS

Configuration 1

Function	Cost ($000)	No. of People	Comment
Telecommunications (hardware)	122	4	Based on current DTIC-S staffing patterns.
Communications (software)	89	3	Based on current DTIC-S staffing patterns.
Data Base Administration	104	4	Based on current DTIC-S staffing patterns.
System Programing and Tuning	64	2	Required to meet response times specified in functional description.
Applications Programing	75	3	Based on current staffing patterns.
Operators	34	2	Based on two-shift operation.
Total	488		

Configuration 2

Function	Cost ($000)	No. of People	Comment
Telecommunications (hardware)	122	4	Based on current staffing patterns.
Communications (software)	64	2	Communications hardware reduces the requirement for communication software development.
Data Base Administration	87	3	This function will require a higher level of expertise. However, much of the routine work will be handled by the data base processors.
System Programing and Tuning	NA	0	It is more cost effective to increase capacity, and therefore performance, by acquiring additional processors.
Applications Programing	87	3	A more sophisticated environment will require a higher level of expertise.
Operators	34	2	Based on two-shift operation.
Total	394		

Configuration 3

Function	Cost ($000)	No. of People	Comment
Telecommunications (hardware)	122	4	Based on current staffing patterns.
Communications (software)	93	3	Additional personnel required to support remote sites.
Data Base Administration	87	3	See configuration 1 personnel costs.
System Programing and Tuning	NA	0	See configuration 1 personnel costs.
Applications Programing	133	5	Application programer at each remote site in addition to those at Cameron Station.
Operators	62	4	One-shift operation at each site.
Total	497		

NEW SITE COSTS

Item	Cost ($000)			
	Los Angeles, CA	Dayton, OH	Boston, MA	Total
Office Space Rental (600 sq. ft. for 1 year)	6	7	8	21
One-Time Start-up Cost	10	10	10	30

a. Los Angeles, Boston, and Dayton were chosen as remote processing sites because of their relatively large DTIC user communities. Close proximity to the processing site reduces telecommunication charges.

b. Six hundred square feet of floor space is estimated to be adequate to accommodate the ADP equipment, a programer, and an operator. The floor space rental costs are relatively low because the ADP equipment does not require a raised floor.

c. The one-time site preparation cost includes office furniture, equipment racks, cabling, etc.

d. Since the difference in utility costs between the three configurations is estimated to be nominal, it is omitted from the analysis.

SYSTEM DEVELOPMENT COSTS

Retrieval system - 3 man-years to develop.1/ Search transaction processing and search set manipulation would require 60 percent of that total. Estimated development cost is $87K.

Update system - 1 man-year to develop.2/ The update system would require 1 man-year effort or $29K.

Assumptions:

a. Mainframe software development tools reduce development costs by 15 percent.

b. A specialized file processor would reduce the development of search transaction processing and search set manipulation by 50 percent.

c. Mini/micro software development tools reduce development costs by 10 percent.

d. Specialized minicomputer software for update processing reduces update development costs by 15 percent.

Configuration	Estimated Software Development Costs ($000)	Cost Reduction Offered by Configuration	Assumption	Projected Software Cost ($000)
Configuration 1				
Update	29	15%	a	25
Retrieval				
Search Process	52	15%	a	44
Other	35	15%	a	30
Total				99
Configuration 2				
Update	29	23.5%	c,d	22
Retrieval				
Search Process	52	55%	b,c	23
Other	35	10%	c	32
Total				77
Configuration 3				
Update	29	10%	c	26
Retrieval				
Search Process	52	55%	b,c	23
Other	35	10%	c	32
Total				81

1/N. Ayala and P. Moncure provided estimates.

2/L. Jenkins provided estimates.

SECTION 5

ADP Strategy

A. Narrative

B. Milestone Plan

C. Summary

A. NARRATIVE

This section of the report outlines a plan to acquire replacement hardware and software to support DTIC's ADP requirements. The plan is based on two major assumptions:

1. Some form of local area network/distributed data processing (LAN/DDP) will be selected.

2. The replacement of current equipment will be done incrementally.

This plan is a sequential ordering of actions to be completed; it is not a time-phased schedule. The schedule for replacement of the ADP system is dependent to a large extent on the resources that can be allocated to the design and procurement efforts. At this time, the availability of these resources, both personnel and dollars, is too uncertain to develop a meaningful schedule.

The plan envisions the formation of a team of technical experts who, under the direction of the ADP Strategy Group will be responsible for the detailed system design and the hardware/software evaluation and selection. The core team of four or five members will be augmented from time to time by additional specialists as needed. One of the first things this team must do is a technical evaluation of the LAN/DDP systems currently available. This evaluation will identify system capabilities and constraints including such things as multivendor compatibilities and throughput limitations. The team will also define in some depth the goals of the replacement system and analyze the resources needed versus those available.

The team will also work with the contractor to develop the Mission Element Needs Statement (MENS) which is the initial part of the procurement documentation required by DLA.

Following development of the MENS, the documentation of the current system's functional processes will be reviewed, updated where necessary, and the functions evaluated in light of need for replacement or modification. The team will analyze the kinds of LAN/DDP configuration available and examine the strengths and weaknesses of various alternatives. The plan envisions the development of a possible system configuration which can be presented in sufficient detail for management review. This strawman system will be evaluated against available systems and under a variety of conditions and revised as needed. When a suitably stable configuration is developed, the detailed system design will be done. At this time detailed resource estimates will be developed along with implementation schedules and the documentation needed to secure DLA approval. At this point the actual phasing of equipment and the procurement strategies, i.e. one phased-in buy versus multiple RFPs, will be evaluated. The final portion of the plan deals with the development of RFPs, equipment/software selection, and testing.

This plan is merely a general outline of tasks. For each of the major areas, subplans and schedules will have to be developed by the project officers or team members assigned responsibility for accomplishing that section of the effort.

B. MILESTONE PLAN

1 DTIC-A APPROVE SYSTEM STRATEGY	2 FORWARD STRATEGY REPORT TO CONTRACTOR FOR FINAL PREPARATION	3 FORM SYSTEM DESIGN TEAM	4 IDENTIFY LAN/DDP CAPABILITIES, CONSTRAINTS, ETC. (see attachment)
5 DEFINE AND PRIORITIZE SYSTEM GOALS AND RESOURCES (see attachment)	6 PREPARE AND SUBMIT "MENS" TO DLA	7 EVALUATE AND DESCRIBE CURRENT SYSTEM FUNCTIONAL PROCESSES (see attachment)	8 IDENTIFY ALL LAN/DDP SYSTEM IMPLEMENTATION ALTERNATIVES (see attachment)
9 SELECT BEST ALTERNATIVE AND FORMULATE DETAILED SYSTEM CONFIGURATION (STRAWMAN)	10 PRESENT RESULTS TO MANAGEMENT	11 DEVELOP LIST OF QUESTIONS, ASSUMPTIONS, FACTS, AND REVIEW GOALS (see attachment)	12 REVIEW LITERATURE VISIT LAN/DDP FACILITIES
13 CANVASS VENDORS - DETERMINE CONTRACTOR SUPPORT AVAILABLE	14 REEVALUATE STRAWMAN SYSTEM - REASSESS GOALS, PRIORITIES, RESOURCES, ETC.	15 PREPARE DETAILED SYSTEM CONFIGURATION SHOWING INDIVIDUAL PROCESSORS, DATA BASES, ETC.	16 PREPARE PHASED IMPLEMENTATION SCHEDULE (see attachment)

17 ESTIMATE PERSONNEL, DOLLAR, AND EQUIPMENT RESOURCES

18 IDENTIFY/LIST DTIC RESOURCE VOIDS AND ALTERNATIVES

19 PRESENT FINAL SYSTEM PROPOSAL TO DTIC MANAGEMENT

20 PREPARE DLA LCM DOC - OBTAIN DLA APPROVAL

21 DEVELOP PHASE 1 SYSTEM SPECIFICA-TIONS BY FUNCTIONAL PROCESS

22 PREPARE "SOW" AND OTHER DOCUMENTATION PHASE 1

23 OBTAIN DLA APPROVAL

24 PREPARE AND SUBMIT RFP(s)

25 PROCURE PHASE 1 HARDWARE/SOFTWARE, ETC.

26 DEVELOP TEST PLAN

27 INSTALL/IMPLEMENT PHASE 1 SYSTEM AND TEST

28 DECLARE OPERATIONAL PHASE 1

29 REPEAT STEPS 21-28 FOR REMAINING PHASES

ATTACHMENT TO FLOW CHART

4. Identify LAN/DDP capabilities.

   - o Survey identifiable networks.
   - o Investigate possible topologies.
   - o Determine network traffic volume/constraints.
   - o Assess compatibility of networks/vendor equipment.
   - o List performance/interface standards.
   - o Determine installation/implementation requirements.
   - o Determine cost variations.

5. Define and prioritize goals/resources.

   o Goals
   Evolutionary system design
   UNIVAC compatible
   Secure
   Fault tolerant/reliable
   Modular
   Multivendor compatible
   Portable

   o Resources
   Personnel
   Travel dollars
   Training dollars
   Contractor support dollars

7. Evaluate and describe current system functional processes.

Functional Area	Data
o Input (RTIS)	o Volume traffic
o Retrieval (DROLS)	o Size records/format
o Request processing	o Data organization/peculiarities
o Output	o Type users
o TAB/indexes	o Usage patterns
o MATRIS	o Operational requirements/constraints
o DTSS	o Etc.
o Etc.	

8. Identify LAN/DDP configuration alternatives.

   (Emphasis on functionality, practically, and evolution, not cost.)

   - o Topologies
   - o Functional modules
   - o Life cycle
   - o Benefits/disadvantages

11. Develop list of questions, assumptions, facts, and revised goals. (Based on information gathered to date.)

- o Implementation criteria
- o Traffic loads/constraints
- o Controls - security, routing, etc.
- o Expansion
- o Availability/operational
- o Cost
- o Sophistication
- o Doable
- o Interface/vendor compatible, gateway
- o Language
- o Network type
- o Reliability/maintenance
- o Etc.

16. Prepare phased implementation schedule.

- o Prepare economic analysis.
  - SARD
  - Draft RFP
  - Etc.

- o Layout LCM phases expressed over time.

- o Define expected results of each phase.

C. SUMMARY

Distributed data processing has always been attractive for certain applications because it distributes intelligence and data in such a way as to increase system performance and decrease system cost. Since the emergence of high-performance small processors, reduced data storage costs, and improved communication technology, distributed data processing has become a cost effective reality. By the end of this decade it is projected that most general-purpose systems will be business oriented and consist of multiple processors dedicated to specific system functions. Variations from tightly to loosely coupled systems will exist but the systems will be modular in design, transportable, more reliable, more secure, and less dependent on human intervention.

The three system configurations described in this report merely contrast three broad system configuration philosophies. Numerous variations of each are possible and the best configuration for an organization is dependent upon many factors; not just technological availability.

DTIC's role in the DoD STI program will continue - even expand over the next decade, however, overall resources will decrease and a change in personnel mix will occur. Classified material will continue to be provided up to the secret level but products will be more user tailored and/or user developed through on-line self-help software. DTIC's data bases will continue to grow as will the number of DTIC users. This user growth will severely strain, if not break, the current ADP system unless changes are begun now.

Technology forecasts indicate increased computer networks, modularity, specialized processors, increased use of micro code vis a vis software, decreased equipment and communications costs but increased system development costs, greater reliance on interactive processing, and increased use of formal programing languages such as Ada and PASCAL. In general, technology advances are making the move from centralized configurations to distributed networks cost effective while offering very attractive performance. Some of the advantages of this new system approach include:

- Lower cost and more effective backup capability
- Easier and faster accessibility to local/specialized files
- Smaller incremental costs for expansion through modular design
- Higher reliability through redundancy
- Less overhead, i.e. operating systems
- Lower total system communications costs
- Simple system operation from user perspective hence easier to tailor products to user needs
- Phased implementation of functional system modules easier

In considering all aspects of this report, we have concluded that DTIC should move toward a distributed network configuration employing a local area network and multiple processors. The best configuration should be determined by separate system analysis action. By so doing DTIC will be able to serve its future customer needs in a cost effective and efficient manner and facilitate growth at minimal cost as user's needs increase.